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WELLINGTON, 21ST JANUARY, 1924.

THE GUM-TREE SCALE AND ITS CONTROL.

DAVID MILLER, Entomologist, Biological Laboratory.

ONE of the most destructive insects to eucalypts is the gum-tree scale or "blight" (*Eriococcus coriaceus* Mask.). It does not confine its attention to any one species but attacks practically all, although some, such as the blue-gum (*Eucalyptus globulus*), suffer more extensively than others.

An examination of a branch or twig from a badly infested tree (Fig. 1) reveals a number of more or less closely packed grain-like bodies attached to the bark. Each of these is reddish-brown, tawny, or sometimes white, and consists of a globular sac of felted material with a circular opening at the posterior end, the whole measuring about $\frac{1}{8}$ in. in length (Fig. 2). Within this sac the female insect lies; the latter is somewhat flattened, oval in outline, blood-red in colour, and possesses six well-developed legs, but no wings. From the under-side of the head a delicate hair-like proboscis projects, being thrust through an opening on the under-side of the enclosing sac towards the anterior end, and thence into the bark of the tree. The insect feeds upon the plant-juices in this way, and in heavily infested cases the drain is so severe that the tree rapidly wilts and eventually may be killed.

Not only is the tree injured through loss of sap, but its death is hastened by the large quantities of the sticky "honeydew" exuded by the insect. This exudation collects on the foliage and bark, and suffocates the tree, while at the same time a black mould grows upon the honeydew, giving the characteristic fire-scorched appearance to infested trees. The enclosed insect is stationary within the sac, which is a permanent fixture, being attached by the under-side to the bark. However, if the sac is damaged in any way the insect frequently withdraws its proboscis and leaves its dwelling.

When the loose bark is stripped from the trunk of an infested tree more or less large white patches are found attached to the young bark (Fig. 3). These patches are composed of innumerable small, white, cottony sacs, each the habitation of a male insect. Unlike the sac of the female, that of the male is loosely woven, oval in outline, and



FIG. 1. EUCALYPT TWIG INFESTED BY FEMALE SCALES, SLIGHTLY ENLARGED.

[Photo by E. B. Levy.]

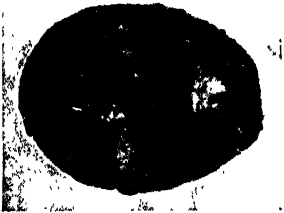


FIG. 2. SAC OF FEMALE SCALE, SHOWING APERTURE AT POSTERIOR END. X 10.

[Photo by H. Drake.]

more or less flat. The male when comparatively young loses its proboscis, but develops a pair of wings and a pair of long white thread-like appendages from the end of the abdomen. The male further differs from the female in passing through a resting or pupal stage in its development. The adult male is a very small, dark-red, two-winged, fragile insect, taking no nourishment.

The female lays no eggs. In the autumn and spring immense numbers of young insects are born alive, and crawl out of the parent sac through the opening at the end (Fig. 2). It is now definitely known that there are two broods of these larvæ, one in the autumn and the other in the spring, but there is no doubt that observations which are being carried out will reveal other broods during the summer

months. During the birth of a brood the young are so small and numerous that they form a fine reddish dust upon the trees, and it is during this stage that the insect is carried long distances by the wind, and, landing on healthy trees in a new locality, spreads the infestation. On settling upon the leaves the larvæ usually take up a position along each side of the midrib, and commence to suck the plant-juices and exude the honeydew. At the same time the beginnings of the protecting sac are secreted in the form of white waxy threads, so that a white strip soon becomes conspicuous along each side of the midrib (Fig. 4). The males take up their position



FIG. 3. PATCH OF MALE SCALES AND FOUR PUPÆ OF THE LADYBIRD.

The scales at upper right-hand corner have been eaten out by the ladybirds. $\times 6$.

[Photo by D. Miller.

beneath the dead bark, but most of the females soon leave the foliage and concentrate along the twigs and younger branches.

The relation of prevailing winds and mountain-ranges to the spread of the scale has been studied, and it is apparent that the spread of the blight is governed almost entirely by these factors. It originally (1900) appeared at Timaru, and was said to have reached that port from Australia on the bark of imported hardwoods. It spread rapidly north and south, and is now well established along the east of the Southern Alps, from Cook Strait in the north to Wairepa, south of Balclutha. In the North Island it first appeared in 1921, in the Marton-Feilding district, and almost simultaneously at Wanganui.

From these west-coast districts it was wind-carried eastward of the main range, chiefly through the Manawatu Gorge, and has thence spread southward to Pahiatua and northward to Waipukurau. On the west side of the range it is at present as far south as Palmerston North.

Although wind is the main agent in dispersal of the blight, birds and winged insects frequenting infested trees are also responsible to a certain extent for its spread.

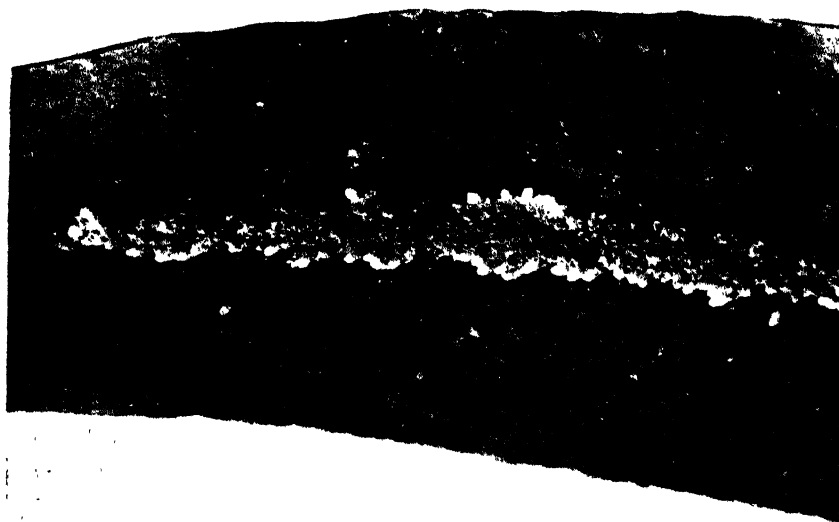


FIG. 4. PART OF EUCALYPT LEAF WITH YOUNG SCALES CONGREGATED ALONG THE MIDRIB. $\times 2$.

[Photo by H. Drake.]

CONTROL.

When the scale became established in the South Island its natural enemy, the ladybird *Rhizobius ventralis*, was imported from Australia by Mr. T. W. Kirk (then Biologist to the Department of Agriculture), and rapidly became numerous enough to control the blight. This beetle was therefore available in 1921 when the scale appeared in the North Island, and large consignments were collected in Canterbury and liberated in the infested areas of the North, where it is now well established. During the past spring more beetles were liberated, particularly round the outskirts of the infested areas of the North Island. Both the beetle and its larvæ attack the scale. The beetle (Fig. 5), which measures from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. long, is much the same size and shape as the common black-spotted yellow ladybird. *Rhizobius ventralis*, however, is black in colour, except for the orange-yellow under-surface of the abdomen. There are no spots on the back, but

the insect appears as if covered with a greyish dust, which, under a slight magnification, is seen to be due to a sparse covering of short, rather coarse, somewhat silvery hair. When the beetle first emerges from the pupa it is of an orange-yellow colour, but this soon changes to black, except on the under-side of the abdomen. It is capable of flight and travels considerable distances. The larvæ (Fig. 6) are reddish-black and torpedo-shaped. The pupæ (Fig. 3) occur under the dead bark of eucalypts and are attached to the trunk; each is globular and dark reddish-brown.

Besides the ladybird the gum-tree scale is attacked by birds, the most active of which are the blackbird, thrush, and fantail. Mr. J. G. Myers (Biological Laboratory) has also observed the white-eye at

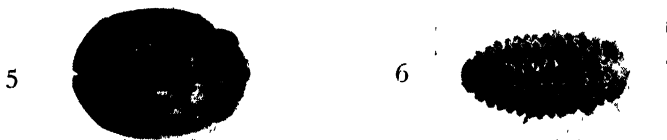


FIG. 5. ADULT RHIZOBIUS VENTRALIS LADYBIRD. $\times 5$.

FIG. 6. LARVA OF LADYBIRD. $\times 6$.

[Photos by D. Miller.

work; while Mr. E. Whitcombe, of Eketahuna, writes that he has observed the tui clearing up the scale. The native bluebottle (*Calliphora quadrimaculata*) frequents the bark soaked with honeydew, upon which it feeds, even feeding on the small drops of the sweet secretion as it collects at the opening of the scale sac. Mr. R. G. Robinson, Superintendent to the Selwyn Plantation Board, states that he has observed the blow-flies suck out the juicy insect within the sac by inserting their proboscis through the opening.

Although the gum-tree scale is well under control in the South Island, and there is every hope of a similar success in the North, an endeavour is being made to secure from Australia certain chalcid parasites and a moth the larva of which is predaceous, in order to make the position more secure.

NOTE—This article is a summary of a detailed and technical work which is being published elsewhere.

Dairy Industry Exhibition at Buenos Aires.—The Argentine Department of Agriculture is organizing an international dairy exhibition to open at Buenos Aires on 5th May, 1924. The scope of the exhibition will include dairy machinery and apparatus, refrigerating machinery, foodstuffs, literature and plans, &c. Space will be free of charge, but exhibitors will bear the expense of installation and display of individual exhibits. All exhibits from abroad will be free of Customs or other duties.

NOTES ON STOCK-BREEDING.

THE QUESTION OF INBREEDING.

Paper communicated to the New Zealand Board of Agriculture by Mr. EDWIN HALL, Onehunga, Auckland.

FEW questions affecting agriculture have excited more controversy than that of the inbreeding and cross-breeding of farm-animals. Charles Darwin spent over five years studying the problem, and finally summed up the position by saying: "That any evil directly follows from the closest interbreeding has been denied by many people, but rarely by practical breeders; and never, as far as I know, by one who has largely bred animals which propagate their kind quickly. When we consider the facts given, which plainly show that good follows from crossing, and, less plainly, that evil follows close interbreeding, the existence of a great law of nature is almost proved—viz., that the crossing of animals and plants which are not closely related is beneficial or even necessary, and that interbreeding prolonged during many generations is injurious."

This conclusion of Darwin's was arrived at more than fifty years ago, but subsequent investigations and scientific discoveries have thrown much light upon the subject that was not available in his day. Have they in any way modified the views he advanced in 1868?

It is well known that the early breeders—Bakewell, Colling, Booth, Bates, Cruickshank, Hugh Watson, and others—all bred-in most closely; partly because they held it was the quickest way of fixing the desired type (and that without a certain concentration of blood no family or herd could permanently improve our live-stock), and partly because their own stock possessed the particular qualities they desired to reproduce, and were better and more potent than any they could buy.

The famous bull Favourite, bred by Colling Bros., was the offspring of a half-brother and half-sister, and was himself mated with his own daughter, granddaughter, and great-granddaughter. He was the sire of Comet, to whom (it has been stated) most of the best Shorthorns trace back.

Bates's "Duchess" family was bred-in most closely for thirteen years; but during the following twenty years he three times introduced fresh blood into the herd on account of lessened fertility and impaired constitution. It is stated that in one season he lost twenty-eight calves from want of constitution; and that out of fifty-eight "Duchess" females which he raised between 1808 and 1844 twenty-four never produced calves. Mr. F. R. Marshall, however, has pointed out that it has not been clearly proved that it was the inbreeding which caused the barrenness in the Bates's "Duchesses," as the third "Duchess" had two barren daughters, by different sires, so that evidently the tendency to barrenness was present in the early members of the family. Bates himself said that to breed in-and-in from a bad

stock was ruin and devastation; yet the practice might be safely followed within certain limits, when the parents so related are both descendant from first-rate animals.

It has been asserted that the bulls raised by Amos and Anthony Cruickshank did more to improve the Shorthorns of Great Britain than any other strain, and that when the reaction set in against the use of Bates's bulls it was their cattle that saved the Shorthorn situation. For over twenty years they had bought high-priced winners for service on the Sittyton herd; but from about 1873 the herd was self-sustaining until its final dispersal. Mr. Amos Cruickshank wrote stating, "I never saw any tendency in either cows or bulls to deteriorate as breeding-animals through old age. Many of my best cattle were the produce of old cows and old bulls. If a bull turned out well I generally kept him as long as he would live and be useful."

Another prominent breeder, Mr. J. Price, said: "My herd has been bred in-and-in for over eighty years, and by far the greater part of it on a direct line on both sides from one cow, now in calf for the twentieth time. I have bred three calves from her by two of her sons, one of which is the largest cow I have, possessing also the best form and constitution; thus showing indisputably that it is not necessary to mix the blood to keep stock from degenerating."

The finest specimens of the American Merino were the result of inbreeding. Mr. Atwood bred his entire flock from one ewe, and they have been bred in-and-in in the United States for upward of sixty years.

Georg Wilsdorf, a noted German authority, says: "We made the astonishing discovery that the best living animals belonged to families which, when traced back, were found to have all come from a single family, often from a single individual."

Mr. James Wilson, speaking of the Aberdeen-Angus cattle, says: "The inbreeding begun by Hugh Watson was continued, though with less intensity, by his successors." The extraordinary concentration of Old Jock blood in Aberdeen-Angus cattle to-day may be gathered from the fact that it would be impossible to find an Aberdeen-Angus animal born within the last five years which is not descended from Iliad more than once.

Gentry, a famous United States pig-breeder, says: "I have practised inbreeding, more from necessity than from any other reason, for twenty years. If it is true that inbreeding intensifies weakness of constitution, lack of vigour, or too great fineness of bone, as we all believe, is it not as reasonable and as certain that you can intensify strength of constitution, &c., if you have those traits well developed in the animals you are inbreeding?"

Professor Davenport quotes another eminent breeder of Berkshire pigs, Mr. A. Lovejoy, as saying, "We are believers in quite close, even inbreeding. It, of course, requires good judgment in mating animals that are particularly strong in individual merit. Should each have a bad defect, we may expect that to be more manifest in the offspring than in the parents, and likewise the good points would be better. So if one mates equally good specimens the produce will be an improvement. There is no sire so prepotent as an inbred sire. When we get

to the point where we feel the need of outside blood we mate an imported sow with our best boar, and from this litter we select a boar to use on the 'get' of his own sire from other sows on the herd—that is, we breed this boar on his own half-sisters."

Much more evidence might be given that tends to show that the great secret of success in stock-breeding is the result of picking the most valuable strains or families, and conserving these valuable "blood lines" by inbreeding and line-breeding. It is not sufficient to select and breed from the best individuals: it is necessary to select the best families, as amongst their descendants will be found the largest number of fine animals. And it is equally important to know the "bad blood" lines. Mr. Evans, the most successful breeder of Milking Shorthorns in England, says: "In breeding for milk, the bull is more than half the herd. You may buy one that may grade your cattle up, but you may get one that will just as quickly grade them down. I would rather have a moderate bull from a good family than a good bull from a poor family."

Mr. Wriedt said: "There is only one animal in a thousand that really builds up a breed. Hunt up the 'blood lines' that are producing the greatest number of good performers, and perpetuate, multiply, intensify these blood lines by moderate inbreeding, or, if necessary, by the strongest form of inbreeding. If this is combined with stringent selection of only the best animals the breeder cannot fail."

The herd-testing breed societies and the agricultural associations might render most valuable assistance in this way.

The Illawarra dairy cattle are said to all trace back to a Shorthorn bull named Major that was imported over seventy years ago. From existing records steps could be taken to ascertain the influence of the bull on the milk-yield of the progeny, and prizes might be offered for the bull that sired five cows giving the best butterfat-yields in the year.

Mumford, summing up the question as to how long it is safe to continue inbreeding, says: "If we limit the term 'inbreeding' to matings between parent and offspring, or between brother and sister, we cannot escape the conclusion that long-continued inbreeding weakens the constitution and decreases the size. Sweeping generalizations are unwise; but mating animals of diverse characters tends to destroy potency. The crossbred animal is never prepotent."

Major Castleman has said: "Inbreeding has produced some of the finest successes and some of the most dismal failures. We sometimes use it, but feel that in doing so we are playing with fire."

William Haynes, after a most exhaustive inquiry about the inbreeding of dogs, claims that line-breeding has proved to be very much more effective than inbreeding, and that out of ten champion Scotch terriers nine were line-bred and only one of them inbred.

The views of both plant and animal breeders have been materially modified during the past twenty years by the discoveries of the Austrian monk Mendel. It seems strange that Darwin, who made such an exhaustive study of the subject, knew nothing of Mendel's work, though he corresponded with Naudin, who did.

Most plant-breeders agree that advances would have been made quicker had the men who were investigating realized sooner that it was not amongst the first cross, but amongst the second generation, they must look for the individuals which would breed true. According to the Mendelian law, two plants or two animals showing the lower (or recessive) factor in the second generation will breed true at once. By breeding from individuals of the second generation, manifesting the dominant factor, one or more will be found that will breed true. "This," says Hurst, "enables the plant-breeder to dispense entirely with the old and laborious method of fixing by continuous selection, which, though usually effective in the end, is now looked upon as a waste of time."

The same law applies to animals. When red cows are crossed with a black bull it will be found that black calves will be produced in the first generation. Thus black is said to be a dominant factor and red a recessive quality. If these first crosses are mated together the second generation will consist of some black and some red (but not of mixtures of both colours), and the blacks will be about three times as numerous as the reds. Of the three blacks generally one will be pure, and two will be masqueraders or black cattle with still a trace of red blood.

When Red Devons were taken to Ireland and mated with Black Kerry cattle the result of the crossing and recrossing was—(a) Some pure black calves; (b) some impure masquerading blacks, or black in colour but with red blood in them; and (c) some pure reds. The Devons also transmitted their shortness of leg; shortness was dominant over length. As Kerry breeders did not like reds, no attempt was made to keep them; but because of the difficulty of identifying, and so eliminating them (when the impure masquerading blacks, with a trace of red, mated), red calves are occasionally born. Professor R. C. Punnett, F.R.S., points out that pedigree is a rough guide in estimating whether the black bull is a pure black or an impure masquerading black; but that certainty can only be arrived at by the direct test of mating with the recessive red. The same results were obtained when the hornless Suffolk cattle were crossed with the horned red cattle.

Bakewell and others tested their bulls on their neighbour's stock by letting them for a season, at the end of which time they were returned to Dishley. Bakewell's success was attributed to the fact that—(a) He was an unparalleled judge of stock; (b) he took enormous pains to get the best stock obtainable; (c) having secured these, he bred from remarkably close relations; (d) he ruthlessly eliminated undesirable stock.

Although Darwin and others failed to recognize it, the work of Mendel threw great light on the subject they were working at. The practical men, the breeders, got good results, but often did not know why, and told people so when asked about their methods. Results could have been obtained more quickly, and at less cost, had they been better acquainted with the discoveries of the scientists. The farmers found out *how*, and the scientists *why*, and the slowness of progress was often because they were working apart in separate watertight compartments.

The late James Little, writing about the development of the Corriedale in New Zealand, states that of his original thirty-one sheep there were only two (one ram and one ewe) that he liked; and he stuck to them as long as he dared—thus working unwittingly in accordance with the views of Mendelian investigators, and with Nilsson, of Svalöf, and other plant-breeders. He was worrying because he could not get a change of blood; but was it not that which enabled him to get his results as quickly as he did? He says he “was haunted by the fear of the results of this constant and unavoidable inbreeding,” although inbreeding was practised by the most eminent breeders. He says later: “I do not call a man a breeder who gets fresh blood every year. He may have one or two good sheep every year; yet his flock will show all sorts of types in wool, and will not have that level appearance all flocks should possess.” For ten years Mr. Little got good results—most robust and prolific sheep. Then they became delicate in each succeeding generation began to show more tail, more pig-mouths, and rough hips, and they became subject to all the ills, &c.; but, curiously enough, every year, he said, “I was getting a few, both rams and ewes, better than I ever had.” Is not this where Mendelism might have helped him? Was it not because the sheep bred from the masqueraders of the second generation were increasing, while the “better than ever” sheep were the progeny of the pure ones?

Professor Punnett says that this work of analysing the results of breeding is only now beginning; but recent works on heredity throw considerable light on many perplexing problems, such as the skipping of characters for a generation, the persistence of the unwanted “throw-back” in even the most highly pedigreed herds, the curious reversion on crossing, and the meaning of the break-up of the type in the second generation from a cross.

Mendel has given us well-defined laws. It is for the breeder to take advantage of them by study of the breed of animals he is dealing with.

Grassing of Hilly Bush Country.—A bush settler back of Wanganui wrote as follows to Mr. E. Bruce Levy, concerning the first article of his series on the Taranaki back-country, published in the September *Journal*: “I should say, allowing for slight differences in altitude and latitude, that conditions in the Whangamomona district are identical with those that prevail here, hence you can imagine I am looking forward with considerable expectation and pleasure to the rest of the series. Your theory of the tawa and kahikatea climaxes is most interesting—they are well exemplified here. I can show every stage from the kahikateas at the bottom to the beeches on the tops of the ridges. Incidentally, your theory settles a long-standing argument I have had as to the reason the beech slopes do not grass readily. In regard to the failure of forest fires to destroy the seeds of trees on the ground, my experience, such as it is, is that as a rule sufficient attention is not given to the underscrubbing, this being especially the case when the felling is done by contract. I have done my own felling and sowing, and have made a point of cutting everything underneath—ferns and tupari as well as supplejacks and vines. Despite the exceeding wetness of the last two seasons I have had pretty fair burns, while my neighbours have often failed to get a burn at all. I am hoping to get a dry season this year and clean burn to try out your mixtures of seed. My best wishes for the success of your work.”

CLOVER-SEEDS.

ECONOMIC SPECIES OF THE GENUS TRIFOLIUM IN NEW ZEALAND.

NELSON R. FOY, Biological Laboratory, Wellington.

THE term "clover" is applied generally not only to members of the genus *Trifolium*, but also to certain members of the genera *Medicago*, *Melilotus*, and *Lotus*. The true clovers, however, are only those which possess the generic name *Trifolium*.

The genus is a large one, there being in all about 275 species in the world, belonging for the most part to the North Temperate Zone. In New Zealand we have about twenty naturalized species, of which only eight or ten are of any economic value. Of these the main ones are: White clover (*Trifolium repens*), alsike (*T. hybridum*), red clover (*T. pratense*), cow-grass (*T. pratense* var. *parenni*), crimson clover (*T. incarnatum*), subterranean clover (*T. subterraneum*), strawberry-clover (*T. fragiferum*), and Egyptian clover (*T. alexandrinum*).

Of these eight species, needless to say, the first five are the most widely used in our grasslands, the last three, particularly Egyptian clover, being the more uncommon. In the following matter the remarks on germination, purity, adulteration, and origin refer in each case to commercial seed.

WHITE CLOVER (*T. REPENS*).—Synonym, White Dutch Clover.

The seeds are small, 1 mm. to 1.5 mm. in length, regular heart-shaped, flattened, margins rounded, one thinner than the other and between the two on each side a slight depression. Surface smooth and dull or slightly shining. Colour yellow with light or reddish brown, or occasionally tinged with green.

Germination is vigorous, showing at least 90 per cent. in a good average line. Seed under 80 per cent. will be old or immature. In freshly harvested lines there is usually a certain percentage of "hard" seeds* (up to 20 per cent.), so called in consequence of the impermeability of the seed-coat, moisture being unable to pass through. As the seed ages a natural softening takes place, and at times this process is accelerated by means of special "scratching" machines, which make minute incisions in the seed-coat.

White clover is usually fairly high in impurities, both in quantity and variety. The percentage (by weight) varies from 0.5 to 15 per cent., the average being about 2.5 per cent. The main impurities are suckling-clover, alsike, sorrel, rib-grass, red clover, English trefoil, scarlet pimpernel, fat-hen, haresfoot trefoil, mouse-eared chickweed, &c. An unusually high percentage of extraneous seeds in a line is usually made up of suckling-clover, alsike, or, less frequently, clustered clover. Clover dodder is the most dangerous of all possible impurities, but generally this is not common in New Zealand seed.

* Seed-hardness is characteristic of all clovers, but more particularly red clover, cow-grass, alsike, and white clover.

Instances of actual adulteration are rare. When it is practised clustered and suckling clover are the main adulterants used. The seed of clustered clover is almost identical with that of white clover, and its bright-yellow colour adds considerably to the appearance of a dull line of white. As with all seeds, the mixing of good and bad lines is not uncommon.

Practically the whole of the white-clover seed used in New Zealand is grown within the Dominion, particularly in the Canterbury, Marlborough, and Hawke's Bay Districts. Only a small quantity is imported, while our export trade in this seed is assuming considerable dimensions.

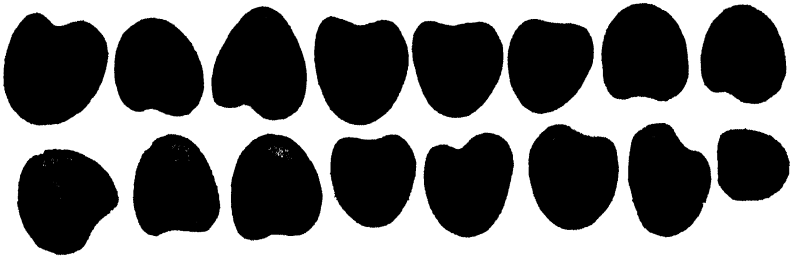


FIG. 1. WHITE CLOVER (*TRIFOLIUM REPENS*). $\times 10$.

[Photo by E. Bruce Levy.]



FIG. 2. ALSIKE (*TRIFOLIUM HYBRIDUM*). $\times 10$.

[Photo by H. Drake.]



FIG. 3. RED CLOVER (*TRIFOLIUM PRATENSE*). $\times 10$.

[Photo by E. Bruce Levy.]

ALSIKE (T. HYBRIDUM).—Synonym, Alsyke.

Alsike is said to be a cross between white and red clover. The seed is of the same shape but slightly larger than that of white clover. Surface smooth and dull. Colour dull yellowish-green to very dark green; some seeds mottled and lighter about the seed-scar.

The average germination is 85 to 90 per cent. A good line should show 90 to 95 per cent.

As with white clover, the percentage of impurities is high, ranging from 0.1 to 10 per cent., with an average of 1.5 to 2 per cent. The main impurities are white clover, English trefoil, timothy, sorrel, suckling-clover, rib-grass, curled dock, camomile, &c. The occurrence of dodder in alsike is extremely rare. In many districts alsike is avoided because of its reputed liability to contain Californian-thistle seed. Some years ago this was undoubtedly true, but at the present time the occurrence of this impurity is comparatively rare.

There is no form of adulteration except seed-mixing. It is of interest to note that before the advent of seed-control in Europe old white-clover lines were dyed green and mixed with alsike as an adulterant.

Very little alsike is grown in New Zealand, practically all our requirements being imported from the United States and Europe.

RED CLOVER (T. PRATENSE).

COW-GRASS (T. PRATENSE VAR. PARENNE).—Synonyms, Mammoth Clover and Perennial Red Clover.

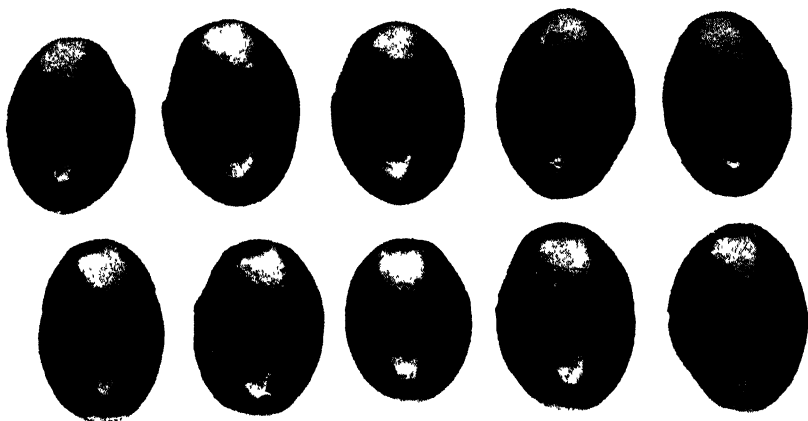
As the seeds of red clover and cow-grass are identical in appearance they will be here dealt with together.

The seeds, 1.5 mm. to 2 mm. in length (average about 1.5 mm.), are roughly triangular or imperfectly heart-shaped—one edge being about one-third longer than the other—flattened, edges rounded, sides convex; a slight depression on each side from the hilum (seed-scar) towards the broad end, the shorter edge being thinner than the long. Surface dull or slightly shining. Colour pure light-yellow to purple, some seeds shading off to violet. A light-brown or tan colour denotes old and dead seed.

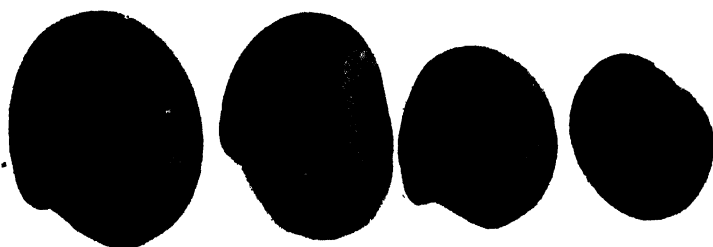
The germination percentage is usually high, more especially in colonial seed. A good average line should show from 90 to 95 per cent. Imported seed, as a rule, is slightly lower than this, 85 to 90 per cent. being the average.

In a well-cleaned commercial line the percentage of impurities is low—from 0.1 to 1 per cent., average 0.5 per cent. Colonial seed is in most cases considerably cleaner than the imported, and the impurities present less harmful. The main impurities are rib-grass (very common, and, when the percentage is high, constituting the major portion of the impurities), curled dock, white clover, sorrel, smartweed, English trefoil, and selfheal. Dodder is rarely found in colonial seed, but is not uncommon in imported seed. American seed is characterized by the presence of a high percentage of green pigeon-grass, Rugel's plantain, and timothy; European, by dodder; and English, by cranesbill.

Adulteration, if present, is by means of seed-mixing.

FIG. 4. CRIMSON CLOVER (*TRIFOLIUM INCARNATUM*). $\times 10$.

[Photo by E. Bruce Levy]

FIG. 5. SUBTERRANEAN CLOVER (*TRIFOLIUM SUBTERRANEUM*). $\times 10$.FIG. 6. STRAWBERRY-CLOVER (*TRIFOLIUM FRAGIFERUM*). $\times 10$.FIG. 7. EGYPTIAN CLOVER (*TRIFOLIUM ALEXANDRINUM*). $\times 10$.

[Photos by H. Drake.]

Considerable quantities of seed are harvested in New Zealand, mainly in the Canterbury and Marlborough Districts, with smaller amounts in the Manawatu district. Imported seed generally appears lighter in colour than colonial, which has a heavier and brighter appearance. In New Zealand all colonial red clover—using the name in a general sense—is, as a rule, bought and sold as cow-grass, there being no differentiation between the two seeds when sown and harvested. Cow-grass becomes red clover, and *vice versa*, as the occasion demands.

CRIMSON CLOVER (*T. INCARNATUM*).—Synonym, Scarlet Clover.

The seeds of crimson clover are fairly large, 1.5 mm. to 2.5 mm. long (average 2 mm.), regular, roughly elliptical in outline, slightly compressed, with the hilum in a slight depression about one-third of the distance on one of the long edges. Surface smooth and shining. Colour buff when new, light to dark brown when old.

The germination of good average seed is 90 to 95 per cent. Newly harvested seeds usually show 90 to 100 per cent. Hard seeds are not common.

On account of its large size the seed is very easily cleaned, the percentage of impurities rarely exceeding 1 per cent. Cut-leaved cranesbill, curled dock, English trefoil, night-flowering catchfly, and field-madder are the most common impurities. Dodder is very rare. Any adulteration is by seed-mixing.

Practically all the seed of this species is imported, mainly from Britain.

SUBTERRANEAN CLOVER (*T. SUBTERRANEUM*).

The name of this clover is probably derived from the habit of the plant in pushing the ripe seed-pods on the lower stems into the soil.

The seeds are very variable in size—1.5 mm. to 3 mm. in length—roughly triangular, with one of the longer sides shorter than the other, and between the two a slight groove on each side. Seed slightly compressed, and much rounded at the end opposite the side bearing the hilum. Surface smooth, dull, or scarcely shining. Colour black, with the faintest tinge of a reddish-purple; some seeds almost of a dark plum colour. Seeds frequently enclosed in a thin membraneous envelope.

Germination is usually not very vigorous, 70 to 80 per cent. being the average. An unusually high percentage of hard seed is always present, which necessarily lowers the germination capacity.

Subterranean clover is easily dressed, and consequently has few impurities. Curled dock and English trefoil are the most common; dodder is very rare. Seed-mixing is the form of adulteration, if any.

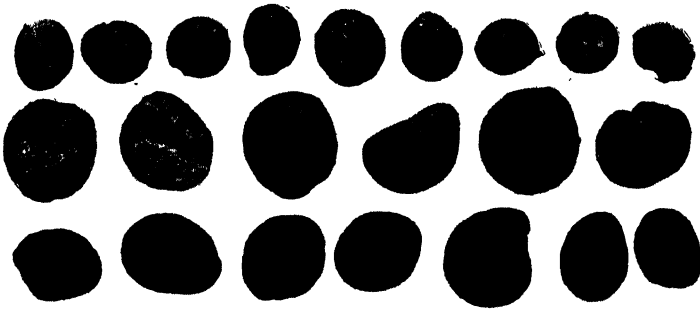
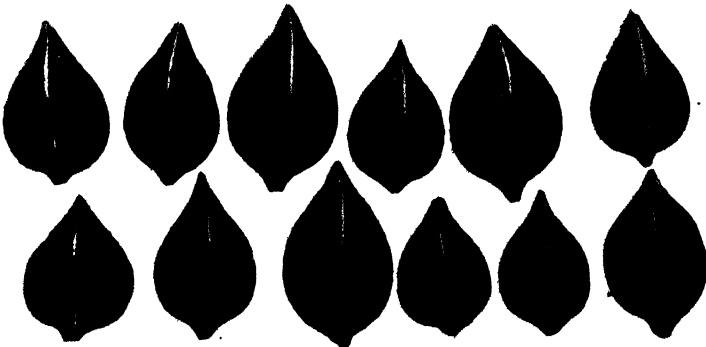
All the Dominion's requirements of this clover are imported from Britain and Australia.

STRAWBERRY-CLOVER (*T. FRAGIFERUM*).

This clover is so called on account of the resemblance of the seed-heads to a fruiting strawberry.

The size of the seed is about 1.5 mm. to 2 mm.—average 2 mm. Shape regular, roughly triangular, rounded at apex, flattened, with a

IMPURITIES OF CLOVER-SEEDS.

FIG. 8. SORREL (*RUMEX ACETOSELLA*). $\times 10$.FIG. 9. DODDER (*CUSCUTA* spp.). $\times 10$.FIG. 10. CURLED DOCK (*RUMEX CRISPUS*). $\times 10$.

[Photos by E. Bruce Levy.]



FIG. 11. RIB-GRASS (*PLANTAGO LANCEOLATA*). $\times 10$.

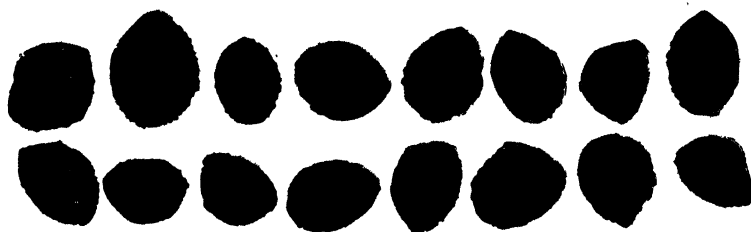
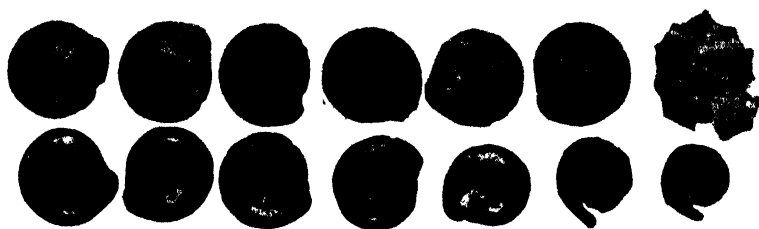


FIG. 12. GREEN PIGEON-GRASS (*SETARIA VIRIDIS*). $\times 10$.

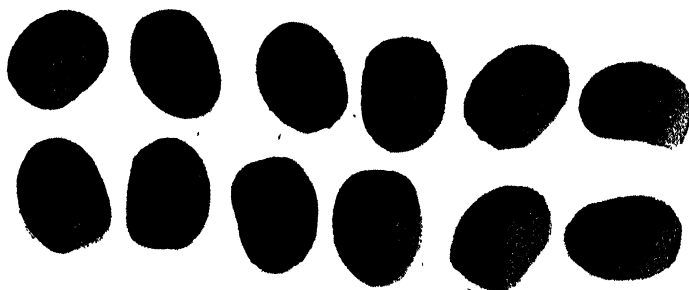


FIG. 13. ENGLISH TREFOIL (*MEDICAGO LUPULINA*). $\times 10$.

[Photos by E. Bruce Levy.

FIG. 14. SCARLET PIMPERNEL (*ANAGALLIS ARVENSIS*). $\times 10$.FIG. 15. FAT-HEN (*CHENOPODIUM ALBUM*). $\times 10$.FIG. 16. SELFHEAL (*PRUNELLA VULGARIS*). $\times 10$.

[Photos by E. Bruce Levy.]

FIG. 17. CUT-LEAVED CRANESBILL (*GERANIUM DISSECTUM*). $\times 10$.

[Photo by H. Drake.]

slight groove running down between the two longer sides. Margins rounded, hilum on the shortest side. Surface smooth and dull. Colour rich yellow to light brown or green, and mottled with dark green. A brown colour denotes old seed.

A good line will germinate up to 95 per cent., and the average is 80 to 90 per cent. Hard seeds are common.

The percentage of impurities is not high, being from 0.1 to 2 per cent., with an average of 0.5 per cent. Rib-grass, curled dock, and sorrel are the main impurities. Dodder is not common.

Strawberry-clover may be adulterated with white clover, but this is not usual.

Australia is the source of origin of our importations of this species.

EGYPTIAN CLOVER (*T. ALEXANDRINUM*).—Synonym, Berseem Clover.

The seeds are 1.5 mm. to 2 mm. in length, averaging 1.5 mm. Shape regular, roughly triangular, slightly compressed; faintly marked groove between the two long margins, the apex of same being very much rounded. Surface smooth and half-shining. Colour light to dark brown, with a faint tinge of green.

A good average line should show 80 to 90 per cent. germination.

The seed is usually very pure, the average percentage of impurities being only 0.5 per cent. Rib-grass, curled dock, and English trefoil are the main impurities.

Adulteration takes the form of seed-mixing.

Australia also supplies our requirements of this clover.

SOME SUB-ECONOMIC SPECIES.

The following *Trifolium* species are usually regarded more or less as weed clovers: Suckling-clover (*T. dubium*), clustered clover (*T. glomeratum*), haresfoot trefoil (*T. arvense*), and low hop trefoil (*T. procumbens*).

SUCKLING-CLOVER (*T. DUBIUM*).—Synonyms, Little Trefoil and *T. minus*.

Seeds are 1 mm. to 1.5 mm. in length, elliptical, slightly laterally compressed; margins rounded, one being narrower than the other; hilum on flattened portion of narrow margin; a light-coloured depression extends downwards from the hilum on either side. Surface smooth and shining. Colour light yellow to pale brown.

Suckling-clover is a common impurity of white clover. It is occasionally used as a pasture-constituent, especially on poor rough country.

CLUSTERED CLOVER (*T. GLOMERATUM*).—Synonym, Cluster Clover.

The seeds are 1 mm. in length, imperfectly heart-shaped, and laterally compressed; margins rounded, one being thinner and shorter than the other; hilum in slight indentation on the narrow margin; on either side a light depression extends from the hilum. Surface covered with minute projections, giving the seed a dull appearance. Colour light yellow to pale brown.

This species is a not uncommon impurity of white clover, and a possible adulterant.

HARESFOOT TREFOIL (T. ARVENSE).—Synonym, Rabbit-foot Clover.

The seeds are 1 mm. to 1.5 mm. in length, elliptical, slightly laterally compressed; margins rounded, one being thinner than the other; hilum on flattened portion of the thinner margin; on either side a dark-coloured depression extends from the hilum. Surface smooth and shining. Colour light apple-green to light brown.

Haresfoot occasionally occurs as an impurity of Canterbury white clover.

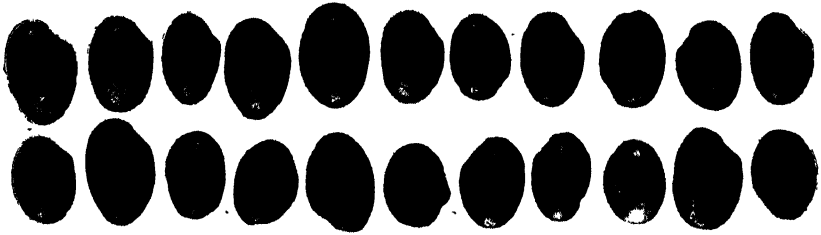


FIG. 18. SUCKLING-CLOVER (*TRIFOLIUM DUBIUM MINUS*). $\times 10$.

[Photo by E. Bruce Levy.]

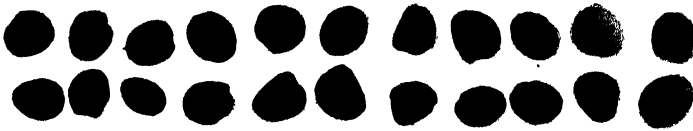


FIG. 19. CLUSTERED CLOVER (*TRIFOLIUM GLOMERATUM*). $\times 10$.

[Photo by H. Drake.]

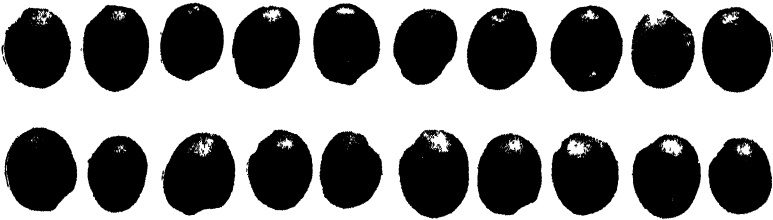


FIG. 20. HARESFOOT TREFOIL (*TRIFOLIUM ARVENSE*). $\times 10$.

[Photo by E. Bruce Levy.]



FIG. 21. LOW-HOP TREFOIL (*TRIFOLIUM PROCUMBENS*). $\times 10$.

[Photo by H. Drake.]

LOW HOP CLOVER (*T. PROCUMBENS*).—Synonym, Hop Clover or Trefoil.

The seeds are 1 mm. in length, long elliptical, slightly laterally compressed, margins rounded; hilum on flattened portion of one margin; on either side a light-coloured depression extends from the hilum. Surface smooth and shining. Colour pale yellow to pale brown.

This clover is very like suckling, only smaller and longer in proportion to the width. It is a rather rare impurity of white clover.

BLACK-SPOT OF APPLE AND PEAR.

EXPERIMENTS IN POSSIBLE METHODS OF REDUCING INFECTION.

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FOR some time now it has been definitely known that in New Zealand the fungi causing black-spot of apple and pear live through the winter in the vegetative stage in the dead fallen leaves, and during the late winter and early spring gradually develop reproductive bodies known as ascospores, which, on being liberated as the buds of the tree unfold, cause a certain proportion of the initial infection of the new season.

In addition to the subsidiary factor of temperature two chief factors govern the discharge of these ascospores, from the chambers in which they are produced, into the air. These two factors are the maturity of the ascospores and the presence of moisture. In exceptional cases immature ascospores are discharged, but as a rule they are retained in the leaf until they have reached their full size; once they are full-grown, however, the presence of sufficient water secures their discharge. In districts, therefore, in which rain may be expected about the time the blossoms unfold, the part played by the ascospore might prove of vital significance in establishing at the beginning of the season a widely spread series of infections which will reproduce in geometrical ratio during the remainder of the season. In districts in which the spring is dry the ascospore probably plays a smaller part in establishing the season's infection. But in districts, such as Nelson, with a fairly heavy spring rainfall it is a question of importance to know what proportion of the total initial infection is caused by the ascospore, so that if the proportion is large some means may be evolved to cope with this danger. This proportion, of course, would not be constant, for many extraneous factors enter into the question.

Three of the more important extraneous factors are concerned with the number of leaves present on the ground having ripe ascospores to eject at the time of rainfall; with the possibility that the lower surface of the leaves from which by far the greatest number of ascospores come faces downwards at the time of spore-ejection instead of upwards, so that the ascospores are not caught up into the air-currents; and with the possibility that the wind may be blowing

in the wrong direction at the time, or be so strong that the ascospores are prevented from falling uniformly on the trees experimented with. Such accidental factors as these naturally prevent the possibility of the proportion of ascospore infection to the total initial infection being determined with accuracy. But the range of the proportions, if determined for several cases, would give an almost equally useful working knowledge of what may be expected to take place.

It was with the object of securing an idea of what this range actually is that an experiment on a rather large scale was carried out in an apple-orchard on the Moutere Hills. The writer is indebted to Mr. George White both for the use of the orchard for this experiment and for his care in carrying out the details of the practical work.

EXPERIMENT 1: TO DISCOVER WHETHER ASCOSPORES FROM DEAD LEAVES PLAY AN IMPORTANT PART IN CAUSING INITIAL INFECTION EACH SPRING.

Two plots were involved in this experiment—the experimental block proper and a control block—each consisting of 6 acres. In the one block the leaves were removed by raking them into rows between the trees and burying them; in the control block they were left on the ground as they had fallen. The object of the experiment was to compare the initial amount of black-spot in the two blocks. The apple varieties comprised Worcester Pearmain, King David, Sturmer, Munro, Statesman, and Delicious.

Treatment: The trees were hoed round in May, and all grass and bracken were removed. The orchard was twice harrowed diagonally to make the ground as smooth as possible. Leaf-fall was complete about July, when the trees were pruned and the prunings removed.

In the experimental plot the leaves were raked both from the base of the trees and from the space between the adjacent trees of the same row, so that finally all the leaves were gathered into unbroken parallel rows running from one end of the block to the other. The tools used were ordinary garden-rakes with a thin steel scraper attached to the back. The raking of the leaves was begun on 29th July and finished on 3rd August. When the raking was finished the leaves were ploughed under. In ploughing, which was "off," twelve furrows were turned, all but the last on either side being 14 in. wide and 7 in. deep. The last furrow, which turned no leaves under, as it was made on the cleared area, was 14 in. by 5 in. The plough used was a heavy 99 Oliver with an ordinary short mouldboard and a skim-coulter. For the last two rows a chain and 18 in. extension were used in order to get close under the trees. The strip left unploughed between the trees was 12 in. to 18 in. wide.

Later cultivation: Ordinary medium-weight tine harrows were used to maintain a soil mulch of about 3 in.

Spray treatment of the blocks: The experimental and control areas were both divided into five parts, those of the experimental block being numbered 1 to 5, and the corresponding blocks in the control area 1A to 5A (Fig. 1). The blocks were so chosen that 1 and 1A contained as many varieties in common as possible; similarly with 2 and 2A, &c.

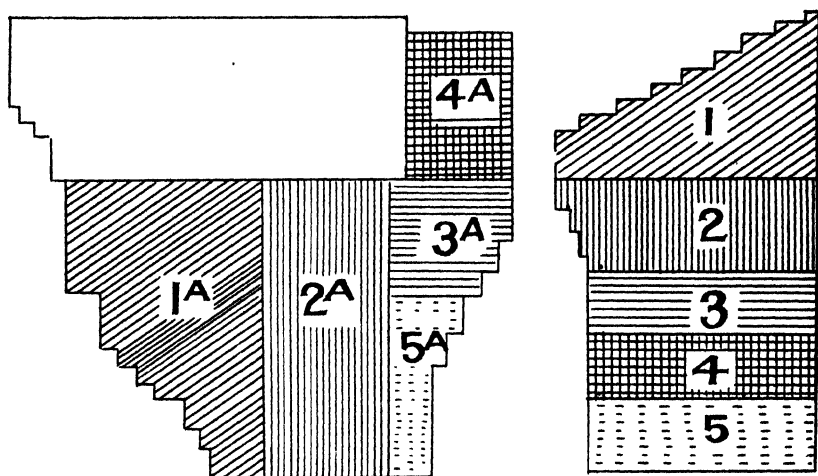


FIG 1. BLOCKS 1-5 AND 1A TO 5A IN THE BLACK-SPOT EXPERIMENT ON THE MOUTERE HILLS.

The number of trees examined in the various blocks is as follows : Block 1, 115 trees; block 2, 94 trees; block 3, 56 trees; block 4, 56 trees; block 5, 56 trees; block 1A, 151 trees; block 2A, 78 trees; block 3A, 44 trees; block 4A, 50 trees; block 5A, 33 trees.

The spray treatment given to block 1 was the same as that given to block 1A; similarly, that given to 2 as to 2A; and so on.

Blocks 1 and 1A received four sprays; blocks 2 and 2A received three sprays; blocks 3 and 3A received two sprays; blocks 4 and 4A received one spray; blocks 5 and 5A received no spray.

The spray used in every case was lime-sulphur. The dates of application and the strength of the spray are given in the following table :—

Dates of Application of Spray.			Blocks.				
			1, 1A.	2, 2A.	3, 3A.	4, 4A.	5, 5A.
7th September	..	..	1-15	..	..	..	..
12th September	..	..	1-15	1-15	..	..	..
29th September	..	..	1-15	1-15	1-15	..	..
12th October ..	..	..	1-40	1-40	1-40	1-40	..

The taking of the records was begun on 28th October, and continued daily until completed. The number of diseased twigs per tree was counted, one diseased leaf being considered sufficient to constitute a diseased twig. The total number of diseased twigs for each variety in the block was determined; this number was divided by the number of trees of that variety in the block, and thus the average number of diseased twigs per tree was secured for each variety.

The final results showing the average number of diseased twigs per tree for each variety is given in the following table. Blank spaces indicate that the particular variety did not occur in the block in question.

Block.	Wm. P.	Station	Sturmer.	Delic.	Munro.	King D.	Average.
1 ●	07	2.	5.	6.			3.
1A		5.	21.	18.	20.	70	31.
2	25	5.	10.	7.			6.
2A		19.	21.	27.	25.	44.	28.
3	3	4.	6.	12.			4.
3A		17.			40.	85.	45.
4	7	5.	8.	47.			8
4A		24.	48.		51.	183.	82.
5	5	8.	12.	38.	7.	55.	24.
5A	53		64.	36.	40.	105.	83.

In every variety the figures for the 1A-5A series should be compared with those for the 1-5 series; by this means is obtained the amount of infection when ascospores are free to play their part in causing infection, and the amount of infection on trees similarly treated and of the same variety when ascospores are not free to cause infection.

As was to be expected, the ratio of the number of diseased twigs in the one series to that in the other series varies in the different varieties. The maximum and the minimum ratios are exhibited by the Sturmers. The maximum is shown by this variety in blocks 4A and 4, where the ratio is 6:1; and the minimum in blocks 2A and 2, where the ratio is (roughly) 2:1. The other varieties show intermediate values in the ratio. The number of trees involved in this experiment is fairly large, and the averages can therefore be accepted as more or less typical. If, then, the minimum reduction in infection through control of the leaves is one-half, it is obvious that control of the fungus in the leaves is a phase in the campaign against black-spot that we cannot afford to overlook.

A double question then arises, as to what is the most effective means of dealing with the leaves, and, secondly, whether that means is practical. An attempt to solve the question was made in the following experiment.

EXPERIMENT II: TO DETERMINE THE RELATIVE VALUES OF BURNING AND OF BURYING THE LEAVES FOR THE PREVENTION OF ASCOSPORE INFECTION.

This experiment was carried out on one variety of apple—Etowah—a block of which was placed at the writer's disposal through the kindness of Mr. H. E. Stephens, of Stoke. Forty-eight trees in three rows, with sixteen trees in each, were used in the experiment. The area was divided transversely to the direction of the rows into three blocks: Block A, five trees per row; block B, five trees per row; and block C, six trees per row (Fig. 2). In block A the leaves were raked from beneath and from between the trees into a series of heaps arranged in parallel lines between the rows of the trees. In block B they were raked out as in block A, but instead of being gathered into heaps they were spread evenly in parallel rows between those of the trees. In block C the leaves were not touched; this block therefore acted as control to the two others. The leaf-heaps in block A were then burnt, after which all three blocks were ploughed (in one direction).

Result: The counting of the number of diseased twigs on the trees was begun on 28th October. The average number of diseased

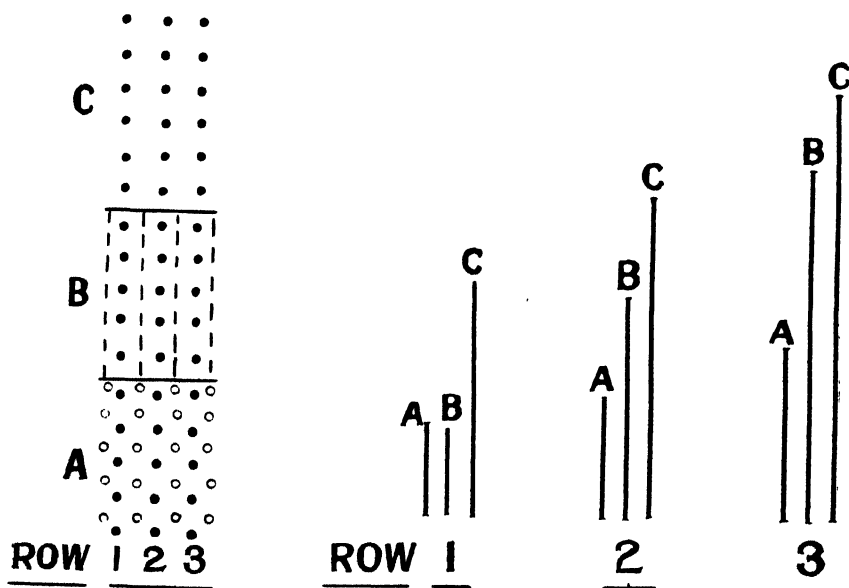


FIG. 2. CONTROL OF BLACK-SPOT INFECTION BY LEAF-BURNING AS COMPARED WITH THAT BY LEAF-BURYING.

A, leaves burned; B, leaves buried; C, leaves untouched. The height of the columns on right indicates the relative amounts of infection.

twigs was:—In block A: row 1, 11·7; row 2, 16·75; row 3, 23·6. In block B: row 1, 11·4; row 2, 31·25; row 3, 49·8. In block C: row 1, 32·5; row 2, 45·4; row 3, 60·3. Therefore the ratio of the average number of infected twigs for the three blocks is roughly: A : B : C = 17 : 31 : 46.

There was therefore least infection in block A, next in block B, and most in block C. With one exception the number of diseased twigs in each row also increased from A to B to C. This exception is in row 1, block A, where there were 11·7 diseased twigs, as compared with 11·4 in block B of the same row. This apparent irregularity, however, is probably to be explained by the fact that two trees were missing from the A part of the row, and that the three that were present in that part were larger than any others in the remainder of the row.

The result of this experiment shows that burning the leaves is more effective than burying them, and, incidentally, as in the previous experiment, that burying the leaves is better than leaving them free on the surface. Unfortunately, however, it was found that raking the leaves from beneath the trees and burning them took too much time. We have therefore to seek some other method, which, while retaining effectiveness in controlling infection from the leaf, can be incorporated more easily into the regular routine of orchard practice. With this object in view a third experiment was undertaken, this time in part of the orchard of Mr. R. Highet, of Stoke.

EXPERIMENT III: TO TEST THE VALUE OF SPRAYING THE DEAD LEAVES TO PREVENT ASCOSPORE INFECTION.

The apple-trees lent for this experiment consisted of a block of Premiers growing on rather low ground. The area was divided into three blocks—A, B, and C (Fig. 3). The trees themselves in all three blocks were sprayed alike, but, in addition, the leaves on the ground in A received three special sprays, in B one special spray, and in C none.

The dates of the special sprays were: In A, 15th September, 15th October, and 26th October; in B, 26th October.

In the average year the majority of the ascospores are discharged within about ten days before and after the beginning of October. As it happened, it was not possible to choose days for spraying that lay within the critical twenty days. For it will be seen that 15th September was early, as many of the ascospores would be immature at that time; 15th October, although near the end of the critical period, was a little late; while 26th October was distinctly too late to show the full possibility of the spray. When ascospores are mature their discharge is dependent on the presence of moisture. At the time of this experiment rain fell on September 10–13, 22–27, and on October 4–8, 12–13, and 21. In addition, therefore, to the normal danger to be expected during the end of September and beginning of October, two exceptionally prolonged rainy periods occurred within that time, and a correspondingly large discharge of ascospores may be expected to have taken place then. So that it is probable that the control by spraying would have been more marked than it proved to be had the ground sprays been applied during the critical period.

But, even as it was, definite control was obtained. The average number of diseased twigs per tree was: In block A, 77; in block B, 187; in block C, 195.

The single spray given to B on 26th October was evidently much too late, as there is little difference in the averages of B and C. Block A, however, with its three sprays, showed a marked reduction in infection, and the control in this case is really greater than the figures indicate, for block A lies lower than B and C, and Mr. Highet states

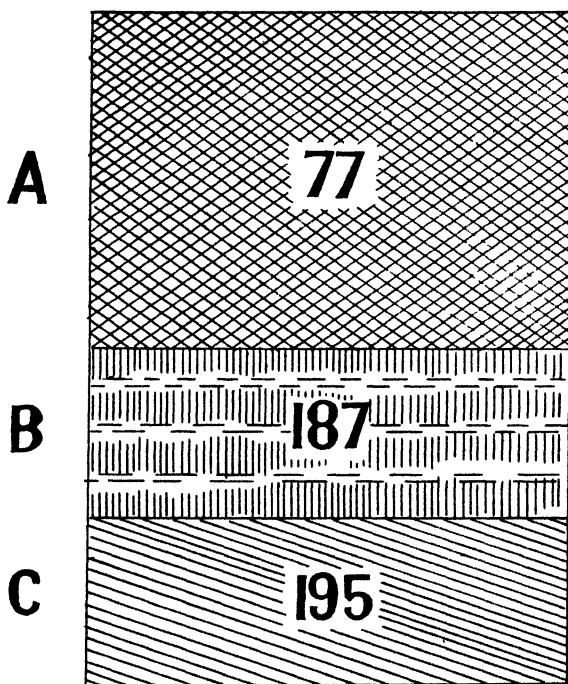


FIG. 3. REDUCTION OF BLACK-SPOT INFECTION SECURED BY SPRAYING THE DEAD LEAVES ON THE GROUND.

A, dead leaves sprayed three times; B, once; C, not at all. Average number of diseased twigs per tree is shown in the figures.

that until the year of the experiment he has always had more black-spot in A than in B or C.

From this experiment it is concluded that spraying the leaves offers promise of a simple practical means of materially reducing infection. In most cases there would be no need for a special mixing of the spray. Except after unusually wet weather the dead-leaf spray need be given only when the normal sprays are being applied to the trees. In the ordinary course of events the leaves on the ground, of course, receive an appreciable amount accidentally when the trees are being sprayed. All that would be required in the normal season is that a little extra time should be devoted to coating the dead leaves thoroughly. When

the spray is being applied to the fallen leaves the force of the pump turns the majority of them over, so that many are sprayed on both sides. As the critical time in the average year extends, roughly, from the beginning of the last week in September to the end of the first week in October, the application of the dead-leaf sprays should be made during this time. If the rainfall that is normally to be expected then (Nelson) is delayed, as happened this season, the dead-leaf spray would naturally be postponed until the rain had come. Application of the spray three or four days before rain does not necessarily prevent the discharge of living ascospores; maximum effectiveness of the spray is secured only when it is applied *immediately after rain*.

LIMING FOR WESTLAND SOILS.

2. TESTS ON THE HEAVIER LANDS.

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IN an article published in the *Journal* for May, 1923, the writer gave an account of experiments carried out at Waimaunga Experimental Farm, on lands fairly representative of the lighter soils of the South Island west coast, which clearly demonstrated the marked improvement in root crops and subsequent pasture on such soils treated with lime, as against no lime or treatment with manures only. That this applies in equal degree to the heavier soils seems to be also clearly shown by tests carried out in other parts of the district, of which the following are examples.

A GREY COUNTY EXPERIMENT.

A trial with lime and manures was undertaken in February, 1920, on Mr. C. Ball's farm, at Rotomanu. Mr. Ball had then been in possession for eighteen months, and the cultural history of the land up to that time was not reliably known. The land is heavy silt drained swamp, and at the time of taking possession was lying fallow, having previously been cropped to some extent.

In the spring of 1920, under ideal weather conditions, the land was ploughed and given good cultivation, and sown in oats together with a grass-mixture, 2 cwt. of superphosphate per acre being used as a fertilizer. The result was a complete failure, the oats being patchy and stunted in growth, while the grass, after brairding quite satisfactorily, rapidly died out. An area of 1 acre was then taken in hand for experimental purposes. After being ploughed in January, 1921, and well worked up, the land was sown in a grass-mixture of perennial rye-grass, 12 lb.; Italian rye-grass, 8 lb.; cocksfoot, 6 lb.; timothy, 4 lb.; cow-grass, 3 lb.; alsike, 2 lb.; white clover, 1 lb.; and Lotus major, 1 lb.: total, 37 lb. per acre. Lime and manures were applied according to the following scheme:—

<p>Plot 1. 1 ton 4 cwt. lime per acre and manures.</p> <hr/> <p>Manure only.</p> <p>(a.) (b.) (c.) (d.) (e.) (f.)</p>	<p>Plot 2. Control.</p>	<p>Plot 3. 2 tons lime per acre and manures.</p> <hr/> <p>Manure only.</p> <p>(a.) (b.) (c.) (d.) (e.) (f.)</p>	<p>Plot 4. Control.</p>	<p>Plot 5. 3 tons lime per acre.</p>	<p>Plot 6. 3 tons lime per acre and manures.</p> <hr/> <p>Manure only.</p> <p>(a.) (b.) (c.) (d.) (e.) (f.)</p>
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Plots 1, 3, and 6 were treated with manures as follows, each manure being applied at the rate of 3 cwt. per acre: (a) basic slag, (b) superphosphate, (c) blood-and-bone, (d) basic superphosphate, (e) equal parts superphosphate and basic slag, (f) equal parts superphosphate and blood-and-bone.

The reason of the failure of the previous sowing of grass and oats was very evidently the necessity for lime in the soil. All the limed plots in the test acre made vigorous growth from the commencement, and excellent pasture was rapidly established on them. On the control plots, and plots with manure only, the seed germinated but made no further headway, and the ground soon became covered with lesser bog-rush (*Juncus uliginos*).

Plot 1, which received the smallest quantity (24 cwt.) of lime per acre, in comparison with the other limed plots was backward in growth for the first twelve months, but has made steady improvement, and is now equally as good. Plot 5 (3 tons lime per acre) equals in quality the limed plots which received lime and manure. This is no doubt due to the heavy dressing applied. The control plots and plots with manure only carried little else than the small rush for the first twelve months. Yorkshire fog and Lotus major have now taken possession. Fig. 1 is representative of the limed plots, and Fig. 2 represents the control plots and plots with manure only. The latter shows the growth of fog, while on the limed plots better grasses and clovers are abundant.

The whole test area has been consistently grazed, except when reserved for hay in the summers of 1921 and 1922. The pasture is now very satisfactory, and well ahead of grasslands sown about the same time on better-class land in the district.

The remaining portion of the field lay fallow from the time of the failure of the pasture and oat crop in the spring of 1920 until the spring of 1922. It was then ploughed during early October, cultivated, and sown to pasture in December, a mixture similar to that employed in the experimental trial being used. One ton of lime per acre was applied. One acre was reserved for a trial with Nauru raw rock phosphate, and treated as follows: Plot 1, $\frac{1}{2}$ acre, 3 cwt. Nauru phosphate per acre; plot 2, $\frac{1}{4}$ acre, 1 ton lime and 3 cwt. of Nauru phosphate per acre; plot 3, $\frac{1}{4}$ acre, $\frac{1}{2}$ ton lime and 3 cwt. Nauru phosphate per acre. Weather conditions were very unfavourable both before and after the sowing.

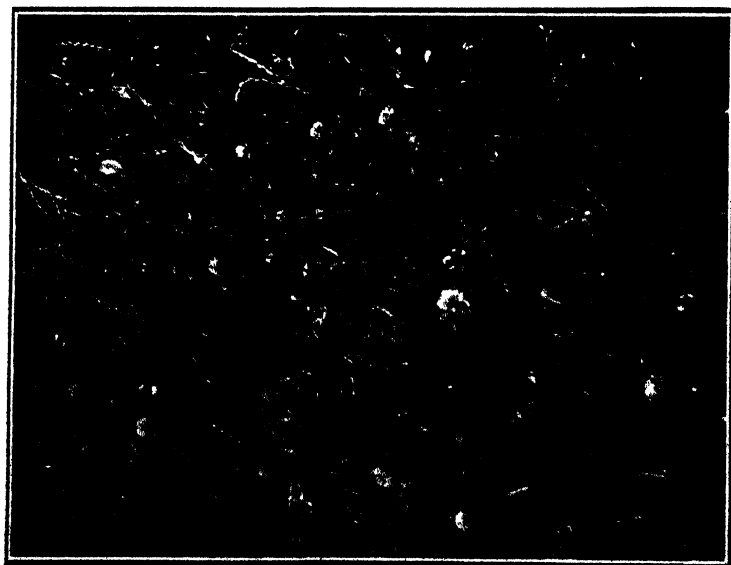


FIG. 1. SHOWING PART OF LIMED PLOTS ON MR. BALL'S FARM,
WITH GOOD GROWTH OF CLOVERS AND BETTER GRASSES.

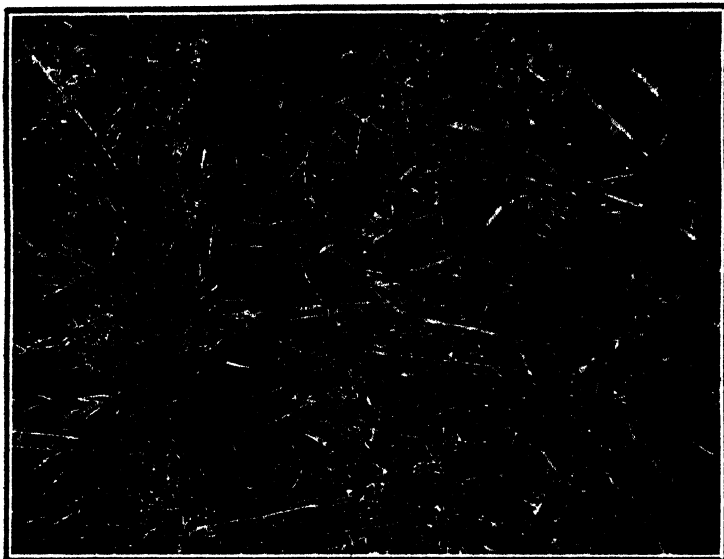


FIG. 2. REPRESENTATIVE OF UNLIMED PLOTS AND PLOTS WITH
MANURE ONLY, YORKSHIRE FOG AND LOTUS MAJOR BEING
THE PREDOMINANT GROWTHS.

[Photos by C. S. Dalgleish.]

Plot 1 (Nauru phosphate only) made a very poor showing; the seed germinated, but growth was poor, stunted, and a bad colour; the grass very soon completely died out, and sorrel is now in possession. Plot 2 and plot 3 (lime and Nauru phosphate) show a decidedly good pasture, which promises well and has been kept closely grazed. No difference is apparent between these two plots, but both show an improvement on the main field, which received lime at the rate of 1 ton per acre, but no fertilizer. Clovers are showing prominently to more advantage.

TEST AT WESTPORT.

At Westport, in the spring of 1918, two grass-mixtures were sown on river-flat formation. Lime was applied at the rate of 2 tons per acre, except $\frac{1}{2}$ chain through the centre of the area, which was left unlimed. Since the time of sowing there has been a continuous first-class pasture, hay being harvested every season. Lime in this instance showed no appreciable improvement until the summer of 1922-23, when the hay crop gave an increase yield of 17.6 per cent. on the land limed over the unlimed land.

PASTURE TOP-DRESSING TRIAL IN SOUTH WESTLAND.

At Waitaha, South Westland, a trial in top-dressing old pasture was undertaken in the spring of 1922-23. The test area comprises a twenty-three-year-old pasture originally sown in perennial rye-grass, cocksfoot, timothy, and clovers. At the time of top-dressing timothy was most prominent, and cocksfoot lightly distributed over the area, with rye-grass and clovers in places. The land is heavy, and carries a fair quantity of rushes, which were mown previous to top-dressing. The area was divided into three plots and treated as follows: Plot 1, 1 ton lime per acre; plot 2, 5 cwt. Nauru rock phosphate per acre; plot 3, 5 cwt. basic slag per acre.

All dressings show an improvement on the old pasture. The limed plot shows to most advantage up to the present, and has given remarkably good results for the period. Basic slag comes next, but is not so pronounced as the lime. Nauru phosphate shows an improvement, but not so marked as the slag. Stock have always shown a preference for the limed plot.

These examples of the beneficial effects of lime are, as already indicated, not isolated cases, but correspond to the experiences of many Westland farmers. The quantity of lime that requires to be applied to the soils of the district is by no means a fixed one: it greatly depends on the nature of the land. On the lighter lands $\frac{1}{2}$ ton per acre will give profitable returns, while on the heavier lands this quantity is not sufficient. At Waimaunga Experimental Farm, Grey Valley, limings ranging from 5 cwt. to 1 ton per acre are being given a trial in the current season.

Lucerne Inoculation.—When procuring inoculated soil in connection with the establishment of lucerne, care should be taken that such soil is well impregnated with the organisms (denoted by abundance of root-nodules), and preferably from a lucerne-stand not less than four or five years old.

RABBIT-POISONING WITH STRYCHNINE.

VARIOUS BAITS AND METHODS.

Live-stock Division.

(I.) CARROTS AS BAIT.

POISONING in this form is very effective in winter, when the carrots are fresh and crisp. If carrots are allowed to become soft and dry, the rabbits do not eat them so well. The methods adopted are as follows :—

(a.) *Strychnine and Sugar sprinkled.*

Cut up 15 lb. of carrots into small cubes, add 1 lb. of icing-sugar, and drain off any liquid after sugar has dissolved. Lay the sweetened cubes in light plough-furrows or scrapes, two cubes every 4 yards apart. Feed in this manner for three nights, and if the rabbits eat the carrots proceed as follows: Cut up 12 lb. of clean carrots into small cubes, add 1 lb. of icing-sugar, and allow carrots to drain until all surplus liquid runs off; grind 1 oz. of strychnine into fine powder, and sprinkle a teaspoonful at a time over the carrots until the ounce is all mixed, stirring well after each application of strychnine; then add 1 lb. of icing-sugar to cover taste of strychnine, and allow carrots to stand for two hours before laying. One poisoned cube every 3 yards is sufficient.

(b.) *Strychnine and Sugar Paste.*

Commence operations by free-feeding the rabbits for two nights in succession with unpoisoned carrots, laid 3 ft. to 4 ft. apart in plough-furrows, scrapes, or spade-chips freshly made. The advisability of liberal free-feeding for at least two nights is strongly recommended—in fact, it is practically essential to success. The baits in free-feeding should be similar to those which are poisoned, and should be laid in the same way. If the baits free from poison are well taken, lay the poisoned carrots on the third day. It has been found advisable to put out about four times the quantity of free-feed as compared with that poisoned. The poisoned baits should be laid from about 6 ft. to 9 ft. apart, according to the infested state of the land.

The mode of preparing the poison is as follows: To 1 oz. of strychnine-crystals add 2 oz. of icing-sugar, and after thoroughly mixing this add enough water to make a thick paste. (Note that the strychnine-crystals will require to be powdered before adding the sugar.) A 4 oz. bottle with wide neck and glass stopper is most suitable for mixing the poison.

When ready to commence laying, have the carrots clean, not washed. Cut the carrot straight across the top with a clean knife, smear the top of the carrot with a little of the poisoned paste, and immediately commence slicing off the baits, so that each bait will have at least a smear of the poison. When all the smeared part is cut from the carrot again apply the paste as before. The baits should be thin, not more than $\frac{1}{8}$ in. thick and about $\frac{3}{4}$ in. across. Each bait only requires a very small portion of the paste-smear (poison).

It is preferable to lay the poisoned baits in the afternoon, and if rain comes on and the result is spoiled in consequence, immediately relay when the weather is again fine. All stock should be removed before poisoning, and if any poisoned baits are left after two or three days gather up and bury. Carrots should be of good quality and clean cut, not bruised.

(c.) *Method for Large Quantities.*

When large quantities are being dealt with the carrots may be cut into cubes by being placed in a strongly made box and chopped up with a spade, then put through a sieve to take out the larger pieces for rechopping. The method of mixing the chopped carrots and sugar (without strychnine) is to place alternate layers of carrots and sugar in the box, and thoroughly stir up and mix together. When the poisoned baits are being prepared, mixing is done in the same way, with the addition of a sprinkling of powdered strychnine on each layer of carrots and sugar, the whole being thoroughly mixed together before removing from the box, so that each piece of carrot may get its share of the strychnine. If this mixture is considered by the user to be too strong it can be weakened by the addition of a few pounds more carrots.

Minced carrots are sometimes used instead of the chopped-up article, and where laid fresh, results have been found satisfactory.

NOTE.—Apples and swede turnips have been successfully used in place of carrots in the foregoing methods.

(2.) OATS AND MOLASSES AS BAIT.

This method has proved very effective, satisfactory kills having been made, and it can be used at any season of the year. It has been tried when there was plenty of pasture, also when feed was scarce, and in both instances results were good. The method is as follows :—

Boil 15 lb. of oats (Garton's preferred) with 2 lb. of molasses or treacle and sufficient water until the oats are soft, draining off any surplus liquid. The oats are then ready to lay for feeding purposes. Run light plough-furrows about 2 chains apart on the land where rabbits feed principally at night, and lay baits of a dessert-spoonful every 4 yards apart in the furrows. In country too rough for the plough lay the baits in scrapes or spade-chips. Continue this for three nights, and if the rabbits are then eating the sweetened oats well, proceed with the poison as follows: Weigh out 24 lb. of boiled oats treated as before mentioned; pour into a wide bath or tub; grind 1 oz. of strychnine into fine powder, and sprinkle a teaspoonful at a time over the oats, stirring well after each sprinkling until the strychnine is all mixed; after which add 2 lb. of sugar to give a sweet coating, as the rabbits having been fed on sweetened oats it is advisable to cover the taste of the strychnine.

Allow the oats to stand for two hours before laying. In laying the poisoned oats one teaspoonful is sufficient every 4 or 5 yards. The furrows used for feeding purposes will also do for the poison.

(3.) GENERAL POINTS.

Special care should be taken that all utensils used in the preparation of the poison are perfectly cleaned, and personal cleanliness should be observed and the baits handled as little as possible. It is held by some that the addition of a small quantity of oil of aniseed to the poison immediately before laying is of advantage in attracting rabbits to the bait, and also in destroying all traces of human handling. The strychnine should be ground as fine as possible, no grittiness to be observable.

As strychnine is highly poisonous, the hands require to be thoroughly washed after the poison has been handled.

STEEPING TURNIP-SEED IN TURPENTINE.

IN connection with the method of steeping turnip-seed in turpentine before sowing, with the object of warding off attacks of the "turnip-fly," a question has been raised as to the effect of such steeping on the germination capacity of the seed. A series of experiments recently carried out at the Department's seed-testing station showed that turnip-seed suffered no diminution in germination after soaking for seven days at a temperature of 65° to 70° F. in pure turpentine. As about twelve hours' steeping is the practice usually followed, a good margin of safety is thus indicated. After seven days the vitality of the seed in the test began to be affected, a loss of 5 per cent. to 10 per cent. in germination capacity resulting from steeping for fourteen days.

SPENT OXIDE AS A MANURIAL DRESSING.

SOME criticism has been expressed of the following paragraph, published in the *Journal* for November last: "Spent oxide, which can often be had from gasworks for the cartage, is rich in sulphur, and also in nitrogenous compounds which when allowed to oxidize on the surface of pasture are transferred into useful nitrogenous fertilizers. The sulphur is also of value on some soils." It is pointed out that spent oxide is used as a destroyer of vegetation, and that nothing will grow where it has been deposited; further, that when lying in bulk its fumes are deleterious to any adjacent vegetation.

Commenting on this criticism the Department's Chemist states that the position of spent oxide is analogous to that of salt, which in large quantities is an excellent weed-killer for paths, &c., and is often used as such, whereas in small quantities it makes an equally good top-dressing for many grasslands or for mangolds and other plants which crave for salt. The Department has used as much as 5 cwt. per acre of spent oxide on pasture with excellent results, a 5-acre paddock having been top-dressed with it. Outside authorities can also be cited as to the fertilizing-value of this material. Care should be taken, however, not to leave it lying in heaps on ground where any growth is desired, nor to apply it heavily for fertilizing purposes.

THE RELATION OF BIRDS TO AGRICULTURE IN NEW ZEALAND.

VII. THE HERONS AND DUCKS.

J. G. MYERS and ESMOND ATKINSON, Biological Laboratory, Wellington.

THE HERONS.

THE heron family comprises birds of powerful flight and wide-ranging propensities. It is therefore no matter for surprise that even New Zealand, isolated as it is by wide stretches of water, receives irregular and doubtless often accidental visits from at least five species of foreign herons, which are, however, far too rare to concern our present interests. There remain four probably resident species; but even among these, two—namely, the little bittern and the white heron—are too restricted in their range or too few in numbers to enter into economic relations with man. Of the beautiful white heron, or kotuku, one large heronry is still known in New Zealand, and it is said that even from this young birds were actually fed to the pigs; but it is highly satisfactory to learn that of late years rigid protection has been enforced, resulting in a marked increase of this interesting and useful species.

There remain, then, two species only—the blue heron and the bittern—which are sufficiently numerous to be considered here; but before these are described a few notes on the order *Herodiones* (herons) as a whole will be appropriate. Closely related to our own white heron, which is in fact grouped among them, are the egrets, noted on the one hand for the cruelty attendant on the collection of their beautiful breeding-plumes for ladies' hats, and on the other for their almost unparalleled service to agriculture. In Egypt particularly a monetary estimate of their value as destroyers of cotton pests reaches a figure which would probably not be credited were we to give it.

It has been suggested that one or more species of the smaller egrets, which in parts of Africa are accustomed to feed on the ticks infesting cattle and other animals—perching gracefully on the bodies of their patients for this purpose—should be introduced into New Zealand to combat the now well-known cattle-tick (*Haemaphysalis bispinosa*). Although in the present case the reputation of the egrets is entirely spotless in their own *native countries*, yet the present writers are strongly opposed to "acclimatization" in any form. In the present state of biological knowledge there is not a single beast or bird the behaviour of which *in a new country* can be definitely predicted. If foreign birds or mammals must be introduced they should first receive the same exact scientific study as is given to insect parasites before these are liberated in New Zealand to combat pests. Furthermore, they should be studied under control conditions in this country before liberation—a proviso easy enough in the case of insects, but very

difficult in the case of birds or mammals. Even then the far less restricted and more readily adaptable feeding-habits of birds and beasts would render utterly impossible any such accurate predictions as can be made when dealing with insect parasites, many of which are restricted in their diet to only one kind of pest, in the absence of which they will starve—a limitation which is at once the strength and the weakness of pest-control by parasites. It was a species of perverted patriotism which led wholly unqualified people in the past to introduce into New Zealand a whole host of foreign birds and beasts a practice which in a considerable proportion of cases has brought serious consequences, often of national extent; it is a higher and nobler and, the writers venture to state, a more profitable patriotism which cherishes and conserves our own native-bird resources.

In the case of the egrets, their introduction as a measure against the cattle-tick is rendered quite unnecessary by the good services of the starling in combating this pest. In most other countries into which the starling has been introduced, notably in America and in Australia, it has been condemned in no measured terms. In New Zealand, whatever be its crimes in the fruitgrowing districts, in North Auckland its destruction of the cattle-tick far overbalances any injurious tendencies.

To return to the herons, the stomach-capacity of the birds of this order may be judged from Leach's remark that in a large flock of straw-necked ibises in Australia "each bird shot contained on the average two thousand young grasshoppers."

The Bittern (Botaurus poiciloptilus Wagler).

The bittern, or matuku-hurepo, of New Zealand is a very near relative of the well-known English species. It is still far from rare, but its numbers will inevitably decrease as the progress of settlement demands the drainage of more and more of the swamps which form its chief refuge. Of shy retiring habits, it is far more often heard than seen, but it is not easily mistaken when once a sight of it has been obtained. Nor is its note likely to be confused with that of any other bird. It is a loud booming, often heard during the day or at night resounding over the swampy flats with a tone like that of a distant motor-car or the bellowing of a far-away bull.

The bird itself is of considerable size, with the long legs and neck of the heron family, and in colour a dark brown with blackish-streaked paler portions, especially on the breast. The long sharp-pointed beak and green legs are very distinct. The greenish-brown eggs are deposited in a well-made, large nest built usually in a swampy situation—often, in fact, in the water itself.

Concerning the feeding-habits of the bittern there are two sides to be considered. Our own bittern occurs also in Australia, and was dealt with by Cleland and his associates in their exhaustive investigation into the food of Australian birds. Although in the single bittern examined the only animal food discovered was "weevils," they unhesitatingly stigmatized this bird as injurious—"from an economic standpoint a pest, destroying many young fish." The experience of the writers in New Zealand will not permit such a

sweeping denunciation. The frequently aquatic nature of its habitat, combined with a peculiar trait in human nature which is strangely apt to suppose that the only food in the water is fish, produce the very general belief that the bittern is predominantly a fish-eater. Even Buller states positively that "it subsists on mice, lizards, eels, and freshwater fish of various kinds." It is important, especially for the farmer, to realize that this is very far from being altogether the case. In the stomach of a bittern found accidentally shot in North Auckland one of the writers counted no fewer than twelve large black crickets (*Gryllus servillei*), two small dragon-flies (*Austrolestes colenisonis*), and two full-fed cutworms of *Agrotis ypsilon*, the black or greasy cutworm—a most widespread and destructive species. There is no evidence here against the belief that insects form a considerable portion of its diet. Doubtless, under favourable conditions more fish would be taken than is indicated above; but in low-lying country where trout are not established, or where suitable streams are absent, there can be no question whatever that the bittern, in destroying such major pests as the large black cricket and the black cutworm, deserves high rank as a bird beneficial to agriculture.

The Blue Heron (Demigretta matook Vieill).

The specific name (the second portion of the scientific appellation) is an ugly corruption of the Maori *matuku*. Our New Zealand blue heron, which is so closely related to the common reef-heron (*Demigretta sacra* Gm.) of Australia and Polynesia that many consider it the same, confines its activities almost entirely to the sea-coast, favouring particularly those parts which are sufficiently rocky to supply pools for its hunting and shelter for its nesting. Such a habitat largely debars it from agricultural consideration. It is, however, an entirely harmless species, and it is a matter for congratulation that such a quaint and charming ornament of our shores should now be on the increase. In many districts the blue heron is commonly known as a "crane." It is important to realize that this is entirely a misnomer, the cranes belonging to quite a different order of birds, with dissimilar feeding-habits, economic bearing, and structure, though with a slight superficial resemblance in general appearance to the herons.

THE DUCKS.

Hitherto we have been concerned with birds chiefly as friends or as enemies. In considering the ducks we find birds playing a different role and entering into much more direct and intimate relations with man—namely, as objects of sport and articles of diet. Some orders of birds there are of which few people think in any other terms; among these are the ducks and their allies, the swans and geese. Under proper game laws rigidly enforced an abundance of sporting-birds is an asset to the country; but the delimiting of shooting seasons, the periodic declaration of close seasons, and the differentiations between species which are wholly protected and those which may be shot under certain conditions—all these render the game laws necessarily somewhat complex, and their enforcement, particularly in the backblocks, a matter of extreme difficulty. Yet it is only by such differential treatment that the practical and profitable conservation of

our native-game resources is possible. In other words, there are some of our indigenous ducks which a very little more shooting would probably exterminate, while there are others which may be shot *in season* without any risk of materially decreasing their numbers, provided that at the same time something constructive is done in the matter of keeping breeding reserves unmolested.

In passing to a more detailed consideration of our New Zealand ducks and their allies we shall include among the latter the black swan and deal with it in this article, thus departing to some extent from our usual custom of treating all the introduced birds in the later articles of the series.

Both in number of kinds and abundance of individuals—particularly the latter—New Zealand is by no means poorly supplied with ducks. Including ducks, geese, and swans we have on our list no fewer than twelve indigenous (all ducks) and three introduced species, but of the former only three are sufficiently plentiful to form legitimate game, while of the latter only one, the black swan, is at all generally distributed. But the four species of waterfowl which can afford legitimate sport are sufficiently numerous in individuals and diverse in feeding-habits to warrant the assertion that no material increase in the total duck population can be expected from any further attempts at the introduction and “acclimatization” of foreign kinds. In fact, there is already competition. Thus G. M. Thomson writes: “Sir Walter Buller states, and Mr. Drummond repeats the statement, that wherever the black swan is found the wild duck (*Anas superciliosa*) disappears.” The sportsmen and would-be “acclimatizers” should take care lest in reaching for the shadow they for ever forfeit the substance.

It is to the interest of every sportsman conscientiously to discriminate between the different kinds of duck which he shoots. In the absence of a New Zealand traditional knowledge like that which helps the shooter in England, and in view of the close resemblance which often occurs between the female ducks of different species, such discrimination as that recommended above, and *demanded* by law, is by no means easy.

Before leaving the consideration of ducks in general it may be well to point out that, quite apart from their relation to the sportsman, these birds have a role of their own to play in nature fully as important in the scheme of things and in its effect on man's welfare as that of other members of the New Zealand bird fauna. As an instance we may note that ducks, even the domestic kinds, are inveterate enemies of mosquitoes in the larval or aquatic stage. Thus McAtee found that ten domestic ducks introduced into a heavily mosquito-infested fish-pond 1,400 square feet in area cleared it of all pupæ (second stage) in twenty-four hours, and of all but the very smallest larvæ in forty-eight hours. Those ducks which feed on fresh-water snails must bear an important part in the control of the destructive liver-fluke of which these snails are the intermediate host.

Taking the New Zealand list in detail, with special attention to those common species which rank as game, and deleting those which are merely stragglers or confined to outlying islands, we come first to the paradise duck.

The Paradise Duck (Casarca variegata Gm.).

This magnificent bird is too well known to need description. From its frequent presence in parks and on ornamental waters it is perhaps better known abroad than almost any other New Zealand bird. In its native country it is fairly abundant in the South Island and much less so in the North Island, becoming increasingly rare farther north. This last season (1923), in response to complaints that flocks of these birds were damaging crops of various kinds, an open season was declared for a limited area only. Although the feeding-habits of the paradise duck may indubitably lead it into incursions of this kind, it is also certain that the damage committed can never be otherwise than of negligible proportions while the species is no more plentiful than it is at present. If the present reduced numbers can commit serious depredations one wonders why the countless thousands which bred on the South Island river-beds in the early days of colonization did not render cropping impossible.

The Grey Duck (Anas superciliosa Gm.).

This bird, which occurs also in Australia and Malaya, is the duck *par excellence* of New Zealand. It is widespread and abundant wherever suitable conditions prevail. It is probably far less appreciated than it should be. Thus G. M. Thomson writes: "In spite of the fact that the native wild duck of New Zealand (*Anas superciliosa*) is as fine a bird both for sport and table purposes as any species of the family that can be introduced, the various acclimatization societies have for many years made continuous efforts to naturalize other species." Buller states that "it is deservedly in high estimation for the table, and may be regarded as perhaps the most valuable of our indigenous birds."

The similarity of the sexes in size and colour, the greyish-brown plumage marked with yellow-white, the white eyebrow, the green speculum or glossy patch on the wing, and the very considerable size, all serve to render this species easily recognizable.

The choice of a nesting-site varies considerably; the nest may be a considerable distance from water, and even at a height in a tree.

The grey duck is placed on the Third Schedule of the Animals Protection and Game Act, 1921: that is, it is ranked as native game, and may be shot, under license, every season.

The Grey Teal (Virago gibberifrons Muller).

This is a rare species, said, however, to breed in the North Island. Perhaps the smallest of our ducks, it is sometimes known as the "little teal." Unlike the so-called black teal and red or brown teal, the present species is a true teal. The brownish back, spotted underparts, white bar and green speculum on wing, coupled with the small size, will aid identification. It is placed on the First Schedule of the Act, and is therefore absolutely protected.

The Brown Duck (Elasmonetta chlorotis Gray).

The brown duck, often known as the "red teal" or "brown teal," occurs nowhere else in the world, nor has it any close relatives. In

New Zealand, moreover, it is becoming very scarce—so much so that its inclusion in the First Schedule of the Act as an absolutely protected bird came not a whit too soon.

The colour is somewhat variable, but the strong tinge of reddish or rufous, and the greenish-black speculum bordered above and below with rufous-white, serve to distinguish it. Its note is very distinct—a fairly shrill, short whistle, which may be represented by the word “wheet.”

The Shoveller (Spatula rhynchotis Latham).

Among sportsmen this beautiful duck often goes by the name of “spoonbill,” in allusion to the shape of the bill. The Maori name is *kuruwhengi*. This “is by no means a common species in any part of New Zealand,” says Buller. Unlike the grey duck and the “black teal” or scaup, it does not congregate to any great extent in flocks. The sexes differ considerably, the female being very much plainer than the beautiful-plumaged male, but the remarkable spoon-shaped bill prevents either from being confused with any other duck in New Zealand.

The shoveller is placed on the Third Schedule (native game), and may be shot under the proper restrictions for each district.

The Blue Duck (Hymenolaimus malacorhynchus Gm.).

The blue duck, mountain duck, or whio, is one of New Zealand's own most peculiar and, we hope, most treasured possessions. To quote Buller: “Far up the mountain-gorge, where the foaming torrent, walled in on both sides, rushes impetuously over its shingle-bed, surging around the huge water-worn boulders that obstruct its course, and forming alternately shallow rapids and pools of deep water, there the blue duck is perfectly at home, and its peculiar whistling or sibilant note may be readily distinguished amidst the noise of the rushing waters.”

The blue duck, easily recognized by its slate-blue plumage spotted with reddish on the breast, is probably of no appreciable economic value; but it is an intrinsically beautiful accompaniment of a type of scenery which embodies the very spirit of New Zealand, and the absolute protection accorded to it should therefore be gladly respected by all.

The Scaup (Fuligula novaeseelandiae Gm.).

This sturdily built little species is more frequently known as the “black teal.” As, however, it is not related to the true teal, but belongs to a totally different subfamily of ducks, this name should not be used.

“It is freely distributed over the country, frequenting most of the rivers and lagoons, but seldom being met with in the bush-creeks, and never on the open seashore. In winter it associates in large flocks, mingling freely with the grey duck and other species; but at other times it is more generally met with in pairs or in parties of four or five together. Its powers of flight are very feeble; it takes wing with reluctance and never rises high in the air, generally only skimming the surface; but it is a very expert diver, and usually trusts to this

faculty for eluding pursuit" (Buller). Apart from the fact that the scaup does, on occasion, fly at a considerable height, the foregoing description is very fine. We may add that the blackish plumage, coupled with the small size and short wings, render the scaup easily recognizable.

It is placed on the Third Schedule (native game), and may therefore be shot under the proper restrictions for each district.

General.

In concluding this necessarily short and somewhat scrappy account of the ducks of New Zealand we cannot do better than quote the following lucid comparative notes by H. Guthrie-Smith. Writing of the blue duck, the brown duck, the scaup, and the grey duck, he states: "Each of these four kinds of duck has its own peculiar haunts and habits. The blue duck will be found in the deep, cool gorges and rushing bouldered streams, and nowhere else. The brown duck breeds probably near the little blind creeks that percolate rather than flow through the marsh-lands. There during the daytime he quietly rests, or, if on larger sheets of water, lurks until dusk in deep shadow and almost motionless. The scaup seems to breed only on the lake's very edge, during the winter months to congregate in large flocks, to be in deep water during the daytime, and under no circumstances to visit the river-beds. The grey duck's nesting-sites are more diffuse: by lake-edge, river-brim, and far from water, even (not very rarely) on trees, their eggs may be discovered. During the day they often rest on flat shore-lands, or swim close along the raupo edge. No one of these breeds interferes with the other, nor do their resting-places overlap."

THE BLACK SWAN (*CYGNUS ATRATUS* LATHAM).

No description is needed of this very familiar bird, which has already become so numerous in many portions of New Zealand—almost, in fact, wherever swamps and lagoons of sufficient size afford it food and resting-haunts. In spite of the fact that it finds a place in the Third Schedule of the Animals Protection and Game Act as "native game," it is, of course, not indigenous to New Zealand, but was introduced from Australia. Largely a vegetable feeder, it is enabled by its long neck to obtain food on a bottom which by shorter-necked or smaller birds could be reached only by diving.

INTRODUCED GEESE AND DUCK.

As already mentioned, only three species of the twenty-five ducks, geese, and swans which have at various times been introduced into New Zealand have become even partially acclimatized. The two we have not yet dealt with are the mallard or English wild duck (*Anas boscas*) and the Canada goose (*Branta canadensis*). G. M. Thomson states that the former is now established in the southern portion of the South Island, and to a less definite extent in the Wairarapa district, while the latter is said to be thriving in portions of Otago and Canterbury. Both species are placed in the Second Schedule (imported game), and may therefore be shot under the proper restrictions. This

schedule includes also no fewer than five other species of foreign ducks and four of geese which have not succeeded in establishing themselves.

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TESTING OF PUREBRED DAIRY COWS.

DECEMBER CERTIFICATE - OF - RECORD LIST.

W. M. SINGLETON, Director of the Dairy Division.

CERTIFICATES are still being issued in large numbers for purebred dairy cows which have been on C.O.R. test, as the lengthy appended list clearly shows. The list comprises all cows which received certificates during the month of December, 1923.

At the request of some of the breeders' associations co-operating with the Department a new feature has been added to these C.O.R. returns—namely, an indication of the number of times daily each cow was milked. An asterisk (*) attached to a cow's name signifies that the cow was milked three times daily during the whole of her lactation period on test, and a dagger (†) that she was milked three times daily part of the period and twice daily for the remainder. In those cases where the name bears no such mark the cow was milked only twice daily throughout her full milking-period.

MILKING SHORTHORN CLASS-LEADERS.

It is pleasing to be able to congratulate Messrs. Ranstead Bros., Matangi, on the possession of two cows which have exceeded the previous highest yield for their class, both names appearing in the current list. Matangi Nancy 2nd, a junior four-year-old, who produced 608.28 lb. of butterfat, has defeated Matangi Jewel, a herd-mate and previous leader of her class, by almost 100 lb. Matangi Ruth 2nd, with a certificate for 747.86 lb. butterfat, becomes the leader of the senior three-year-olds and champion of the Milking Shorthorn

breed in New Zealand. As a class-leader she supersedes Mr. De la Haye's Terrace View Rosy 2nd by 170·86 lb. fat, and as champion of the breed has exceeded the performance of Messrs. Ranstead Bros.' fine old cow Maniaroa Princess by 47·10 lb. fat.

Both Matangi Ruth 2nd and Matangi Nancy 2nd were sired by Dominion Esau of Ruakura, a bull bred by the Department of Agriculture at the Ruakura Farm of Instruction, Hamilton East. This bull is from Dominion Jean of Ruakura, who has a C.O.R. for 532·61 lb. fat in 344 days, at eight to nine years of age. Matangi Nancy 2nd is from Matangi Anne, who has a C.O.R. for 483 lb. fat. Dominion Esau of Ruakura is also the sire of Matangi Quality 4th, with 591 lb. fat, Matangi Cherry 1st, with 360·77 lb., and Matangi Pauline, with 293·84 lb. as a junior two-year-old.

There is therefore adequate evidence that these two outstanding cows are from a family which has proved itself capable of sound production.

LIST OF RECORDS, DECEMBER, 1923.

Name of Cow and Class	Tested by	Age at Start of Test.	Fat req'd for Cent.	Yield for Season.		
				Days	Milk	Fat

JERSEYS.							
<i>Junior Two-year-old.</i>		Yrs	dys	lb	lb.	lb.	
Alfalfa Sweet Heather	F. J. Saxby, Hamilton	1	316	240·5	365	9,655·2	649·57
Alfalfa Daisy ..	F. J. Saxby, Hamilton	1	314	240·5	365	8,578·7	552·21
Alfalfa Fox's Serenade	F. J. Saxby, Hamilton	1	329	240·5	365	9,502·2	533·64
Jersey Park Fancy ..	D. Kennedy, Morven	2	13	241·8	365	9,382·4	533·50
Spec's Girl ..	A. J. Harris, Bombay	1	266	240·5	365	8,945·4	522·35
Rewa Merequest ..	W. H. Booth and Sons, Carterton	2	34	243·9	365	9,097·0	508·81
Glorious Ringlet ..	L. W. and J. T. Prosser, Leeston	2	24	242·9	357	7,453·6	503·72
Richwood Dot ..	R. E. Clements, Awakino Point	1	332	240·5	365	8,465·45	451·54
Workshop Sunshine ..	H. H. Sutton and Co., Longbush ..	1	358	240·5	365	9,464·0	451·29
Sunnibelle ..	J. Nicholson, Manakau	1	314	240·5	365	8,333·8	447·66
Sunny Meadows Ivy	F. J. Wyatt, Towai ..	2	7	241·2	365	6,418·2	442·73
Belvedere Beryl ..	J. A. Pettigrew, Pihama	2	31	243·6	365	6,986·1	439·45
Burnside Gem ..	S. J. Holland, Rowan	1	313	240·5	365	6,682·25	437·90
Round Bush Fuchsia	F. W. Cornwall, Bell Block	2	25	243·0	365	7,188·6	433·11
Viola's Belle ..	J. Nicholson, Manakau	1	312	240·5	365	7,472·7	430·47
Silverdale Alma ..	G. Hodgson, Whakapara	1	291	240·5	365	7,498·3	430·15
Fernaig Fairy ..	C. Parker, Hairini ..	1	364	240·5	365	6,545·4	424·63
Woodstock's Windflower ..	Mrs. A. Banks and Son, Kiwitea	1	355	240·5	365	8,596·3	422·71
Rewa Merriflower ..	W. H. Booth and Sons, Carterton	2	9	241·4	365	9,537·3	414·12
Jerseydale Mermaid	J. Pettigrew, Pihama	2	45	245·0	365	6,880·8	411·00
Silverdale Joan ..	G. Hodgson, Whakapara	1	303	240·5	357	6,860·7	398·84
Fury's Enid ..	W. J. Spooner, Awapuni	2	61	246·6	365	7,830·4	398·05
Orange Dale's Briar	W. J. Hall, Matatoki ..	1	339	240·5	344	8,058·5	395·18

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cwt.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS—continued.						
Junior Two-year-old—continued.		Yrs. dys	lb.		lb.	lb.
Poplarvale Bluebell ..	R. C. Henry, Bell Block	2 3	240·8	365	6,029·6	394·58
Sunny Meadows Bluebell ..	F. J. Wyatt, Towai ..	2 31	243·6	365	7,180·8	393·56
Silverdale Bella ..	G. Hodgson, Whakapara	1 355	240·5	365	8,030·4	387·52
Beechlands Heather ..	Moreland and Son, Te Rapa	1 335	240·5	313	7,042·1	386·35
Treasure Queen ..	C. B. Herrold, Waiuku	1 340	240·5	364	6,392·9	376·69
Poplarvale Rosabell ..	R. C. Henry, Bell Block	1 345	240·5	365	5,777·7	374·52
Sunny Meadows Lily ..	F. J. Wyatt, Towai ..	1 322	240·5	365	5,767·0	372·29
Sundial ..	A. R. Valder, Manga-whare	1 227	240·5	365	6,257·3	366·08
Tawa Berry ..	J. Nicholson, Manakau	2 27	243·2	304	6,465·6	364·49
Ivondale's Rainbow Lass ..	P. J. Petersen, Brixton	1 342	240·5	340	6,830·6	358·20
Curlene ..	J. A. Pettigrew, Pihama	2 41	244·6	365	6,461·9	353·51
Ivondale's Rose Blossom ..	P. J. Petersen, Brixton	2 49	245·4	340	7,409·3	352·80
Noble Golden Fern ..	C. Stevens, Maungata-pere	1 350	240·5	365	6,754·1	343·67
Wotton Plush ..	S. R. Lancaster, Palmerston North	2 86	249·1	365	6,003·5	331·97
Brown Leaf ..	F. E. Day, Tamahere	1 363	240·5	365	5,723·8	330·84
Holly Oak Flash Lady ..	J. Hale, New Plymouth	1 240	240·5	301	5,885·2	325·54
Vicella ..	T. Foreman, Alton ..	2 0	240·5	365	5,973·0	309·92
Ivondale Girl ..	P. J. Petersen, Brixton	2 61	246·6	308	6,780·5	308·85
Gaytime ..	F. E. Day, Tamahere	2 38	244·3	365	4,818·1	300·88
Maori Flower ..	G. L. Lewis, Fendalton	1 272	240·5	305	5,220·1	295·98
Zanita ..	A. Rogers, Katikati ..	2 20	242·5	365	5,838·7	291·45
Fawn Princess ..	F. E. Day, Tamahere	2 20	242·5	316	5,223·4	266·29
Remuera Premier ..	E. H. Linnell, Midhurst	2 10	241·5	339	4,455·7	259·91
Stylish Briar Flower ..	F. E. Day, Tamahere	2 7	241·2	358	4,826·9	251·92
Senior Two-year-old.						
Silverdale Stella ..	G. Hodgson, Whakapara	2 337	274·2	365	10,099·2	583·14
Dianella ..	J. Nicholson, Manakau	2 346	275·1	365	10,090·3	572·92
Parakau Hopeful ..	D. A. B. Allison, Pukekohe	2 350	275·5	355	8,945·9	500·26
Jersey Brae's Bonnie ..	W. H. Miers, Rukuhia	2 341	274·6	365	8,566·8	497·42
Dilemma ..	J. Nicholson, Manakau	2 175	258·0	364	8,082·8	494·58
Ivondale's Belgium Girl ..	P. J. Petersen, Brixton	2 364	276·9	326	7,803·0	421·35
Ivondale's Waitress ..	P. J. Petersen, Brixton	2 328	273·3	322	7,971·6	397·16
Ivondale's Pretty ..	P. J. Petersen, Brixton	2 314	271·9	331	8,447·3	392·62
White Phlox ..	F. E. Day, Tamahere	2 360	276·5	352	5,932·8	327·23
Fernaig Freda ..	S. C. Colmore-Williams, Dargaville	2 130	253·5	311	5,049·7	314·53
Burnside Dusky ..	S. J. Hollard, Rowan	2 108	251·3	297	5,158·0	300·43
Lady Sweetheart ..	A. J. Harris, Bombay	2 305	271·0	294	4,927·1	293·38
Ivondale's Cream Carnation ..	P. J. Petersen, Brixton	2 329	273·4	200	6,166·3	276·95

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season		
				Days	Milk.	Fat.

JERSEYS—continued.

<i>Three-year-old.</i>		Yrs	dys.	lb.	lb	lb.
Oaklands Ruebe ..	F. W. Cornwall, Bell Block	3	349	311·9	365 12,948·3	696·22
Oaklands Guernsey	F. W. Cornwall, Bell Block	3	14	278·4	365 10,565·3	692·54
Grey Gown of Rosy Creek	H. George, Kaupokonui	3	23	279·3	365 11,490·4	607·30
Pet's Top ..	H. J. Burrell, Bunythorpe	3	56	282·6	305 9,747·6	602·36
Orange Wait ..	H. J. Burrell, Bunythorpe	3	39	280·9	305 9,425·3	563·80
Richwood Molly ..	C. Parker, Haimi ..	3	354	312·4	365 9,261·5	555·60
Oaklands Lindazelle	F. W. Cornwall, Bell Block	3	60	283·0	365 8,628·7	552·07
Orange Dale's Olga	W. J. Hall, Matatoki	3	11	278·1	365 9,062·5	536·50
Jerseydale Tricksey ..	J. Pettigrew, Pihama	3	75	284·5	363 8,599·1	525·15
Beachlands Malvoisie	Moreland and Son, Te Rapa	3	10	278·0	305 11,314·7	518·71
Holly Oaks Lala ..	H. H. Sutton and Co., Longbush	3	74	284·4	364 9,096·5	500·35
Ensley Princess ..	R. F. Wilkinson, Pukekohe	3	360	313·0	365 8,158·1	480·80
Rosendale's Pride ..	R. J. Ballantine, Normanby	3	362	276·7	365 7,625·4	474·38
Statice ..	J. Nicholson, Manakau	3	355	312·5	365 9,459·5	468·01
Holly Oaks Princess	R. R. Dean, Te Kumi	3	20	279·0	346 9,192·3	467·59
Woodstock's Flirt ..	A. Banks and Son, KIWITEA	3	27	279·7	365 8,493·5	465·77
La Volupta ..	G. A. Gamman, Marton	3	5	277·5	365 9,156·6	456·51
Iscia Mahone ..	C. Stevens, Maungata-pere	3	39	280·9	365 7,968·3	447·64
Daystar's Choice ..	C. Meuli, Tariki ..	3	63	283·3	338 7,539·4	437·68
Ivondale's Heather Girl	P. J. Petersen, Brixton	3	339	310·9	302 7,571·0	433·92
Orange Dale's Butter	W. J. Hall, Matatoki	3	5	277·5	344 8,311·1	430·73
Aberbrothock's Aster	W. P. Begg, Arapohue	3	27	279·7	365 7,536·1	428·51
Lassie Wisp ..	W. Muir, Waihi ..	3	251	302·1	296 5,941·9	353·67
Belvedere Lily ..	A. J. Cotton, Wakatu	3	18	278·8	365 5,887·8	332·32
<i>Four-year-old.</i>						
Miro Meadows Rita ..	A. A. Ward, Tariki ..	4	11	314·6	365 10,290·8	625·94
Oakland's Primrose ..	F. W. Cornwall, Bell Block	4	11	314·6	365 10,650·2	589·79
Jersey Bank Jolly ..	R. C. Jury, Tikorangi	4	4	313·9	365 11,496·1	573·86
Pride ..	R. E. Clements, Awakino Point	4	80	321·5	365 8,325·9	451·88
His Lordship's Lady	W. H. Waterhouse, Runciman	4	4	313·9	365 8,629·2	387·86
<i>Mature.</i>						
Belmont Novice ..	G. H. Stiles, Palmerston North	6	217	350·0	365 13,576·6	811·26
Hawkesbury Peeress	H. Salway, Bell Block	6	3	350·0	365 12,949·2	712·37
Charming Irene ..	C. Stevens, Maungata-pere	7	294	350·0	365 11,956·8	687·51
Oakden Bonnie† ..	J. H. Sherrard, Otatau	7	80	350·0	365 12,524·8	685·19

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert	Yield for Season		
				Days.	Milk	Fat

JERSEYS—*continued.*

		Yrs. dys.	lb.		lb.	lb.
<i>Mature—continued.</i>						
Molly Mahone ..	C. Stevens, Maungatapere	9 28	350·0	365	11,252·3	665·30
Flox ..	Moreland and Son, Te Rapa	5 191	350·0	365	9,157·6	645·26
Miro Meadows Maud	A. A. Ward, Tariki ..	7 61	350·0	365	11,551·6	623·62
Duchess of Woodstock	A. Banks and Son, Kiwitea	6 52	350·0	283	10,201·9	575·12
Maori Gem ..	H. B. Lepper, Lepperton	7 9	350·0	352	10,934·6	568·21
Gem's Mamy ..	H. B. Lepper, Lepperton	8 346	350·0	352	10,985·8	556·45
Pink Chase ..	W. J. Hall, Matatoki	6 236	350·0	365	8,914·0	555·87
Blackberry ..	J. Nicholson, Manakau	5 325	350·0	365	9,857·4	546·95
Viola's Golden Girl ..	R. J. Wilson, Putaruru	5 46	350·0	365	8,215·7	529·37
Cynthia ..	T. H. Verry, Pahiatua	10 236	350·0	365	11,514·6	525·71
Olga's Butterman Chase	W. J. Hall, Matatoki	10 16	350·0	344	8,827·5	522·43
Cynthia of Konini ..	T. H. Verry, Pahiatua	5 300	350·0	350	11,018·3	521·73
Coriopsis ..	C. Stevens, Maungatapere	7 338	350·0	365	10,343·9	517·14
Lady Nonnie ..	M. V. Reeve - Smith, Aria	5 346	350·0	329	8,982·1	500·95
Fern Grove Louise ..	H. J. Burrell, Bunnythorpe	5 339	350·0	365	8,836·3	477·38
Rewa Amber ..	H. H. Sutton and Co., Longbush	7 325	350·0	333	9,403·0	455·56
Middlewood's Wonder	Moreland and Son, Te Rapa	9 341	350·0	365	9,019·3	449·65
Hillsbourne Belinda	G. A. Gamman, Marton	5 49	350·0	328	7,625·2	447·45
Stromna's Blue Bell	G. Hodgson, Whakapara	7 45	350·0	351	7,745·8	446·20
Aberbrothock's Queen	A. R. Valder, Manga-whare	5 358	350·0	321	7,324·8	429·00
Lilian ..	H. W. Nicholls, Belgrove	11 73	350·0	326	8,264·3	421·47
Ivondale's Lady ..	P. J. Petersen, Brixton	10 4	350·0	336	7,346·4	417·24
Rioter's Chase ..	W. J. Hall, Matatoki	7 43	350·0	342	8,070·4	414·05
Bright Eyes of Beachlands	C. Parker, Hairini ..	9 4	350·0	276	7,407·2	402·80
Dream's Diadem ..	E. H. Linnell, Midhurst	9 296	350·0	365	7,604·3	351·62

FRIESIANS.

<i>Junior Two-year-old.</i>						
Dominion Krugersdorpf	Central Development Farm, Weraroa	1 330	240·5	365	13,653·4	447·56
Pareora Mentor Lass*	A. S. Elworthy, Timaru	2 59	246·4	365	11,989·4	444·92
Dominio Colantha Belle*	W. I. Lovelock, Palmerston North	1 322	240·5	365	11,043·2	442·44
Dominion Wild Violet†	Central Development Farm, Weraroa	1 342	240·5	365	12,128·0	439·30
Dominion Sarcastic Lassie	Central Development Farm, Weraroa	2 31	243·6	365	11,594·3	365·64
Everslea Magpie Girl	G. H. Hassall, Clarkville	1 321	240·5	365	10,314·1	326·33

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test	Fat req'd for Cert.	Yield for Season.		
				Days	Milk.	Fat.
FRIESIANS—continued.						
Junior Two-year-old—continued.		Yrs. dys.	lb.		lb.	lb.
Dutchmaid 4th Gem†	N. P. Nielsen, Tiakita-huna	2 30	243·5	317	9,184·7	302·40
Hanley Betty ..	G. H. Hassall, Clarkville	1 294	240·5	365	9,402·3	298·09
Senior Two-year-old.						
Bloomfield June de Kol*	Bloomfield Farm Co., Wellington	2 195	260·0	323	12,768·6	465·49
Pontiac Blossom of Glen Lynne†	S. Clements, Rototuna	2 209	261·4	330	12,482·7	427·98
Longbeach Transvaal Star*	J. H. Grigg, Longbeach	2 184	258·9	365	12,843·7	402·11
Pareora Aaggie* ..	A. S. Elworthy, Timaru	2 306	271·1	365	13,928·4	390·79
Lady Marquis Snow-drop†	Voss Bros., Longburn	2 349	275·4	365	10,865·6	326·60
Junior Three-year-old.						
Dominion Johanna Woodcrest	Central Development Farm, Weraroa	3 11	278·1	365	14,174·0	441·03
Snowdrop Oak† ..	Voss Bros., Longburn	3 18	278·8	360	11,620·4	409·46
Pearl 2nd† ..	N. P. Nielsen, Tiakita-huna	3 28	279·8	365	12,124·6	402·28
Dominion Lady Piebe	Central Development Farm, Weraroa	3 24	279·4	360	9,864·7	339·48
Senior Three-year-old.						
Hinemoa Beauty* ..	T. R. Eades, Edendale	3 301	307·1	365	23,145·5	812·44
Monavale Felicity Paxton*	R. Marr, East Tamaki	3 325	309·5	365	12,544·1	529·01
Junior Four-year-old.						
Dominion Lady Olga	Central Development Farm, Weraroa	4 19	315·4	351	10,549·9	333·47
Senior Four-year-old.						
Sadie Van Friesland Park†	P. F. Boucher, Kumeu	4 300	343·5	365	12,336·2	468·66
Dominion Jessie Beets†	Central Development Farm, Weraroa	4 277	341·2	287	14,115·9	448·04
Dominion Manola 2nd†	Central Development Farm, Weraroa	4 245	338·0	318	13,682·8	435·24
Mature.						
Burkeyje Sylvia Posch*	North and Sons, Omimi	10 187	350·0	365	22,974·4	716·87
Maud Fayne Johanna 2nd†	Voss Bros., Longburn	6 189	350·0	365	17,195·0	635·84
Monavale Creamelle Regina†	S. Clements, Rototuna	7 62	350·0	318	15,457·9	606·13
Dirk Belle de Kol* ..	E. F. Peacocke, Hamilton	7 321	350·0	365	16,316·3	592·21
Hengerveld Belle Segist†	P. F. Boucher, Kumeu	7 358	350·0	365	16,426·6	561·64
Rosevale Ruby* ..	North and Sons, Omimi	5 359	350·0	365	16,171·4	525·48
Lily de Kol† ..	S. Andrew, Kaikoura	5 318	350·0	365	16,715·4	510·36
Glenlassie de Kol of Te Ngutu†	S. Clements, Rototuna	6 247	350·0	336	17,092·0	486·95

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days	Milk.	Fat,
FRIESIANS—continued.						
Mature—continued.		Yrs. dys.	lb.		lb.	lb.
Riverdale Fancy† ..	E. F. Peacocke, Hamilton	7 308	350·0	364	16,768·7	485·95
Dutchmaid 4th† ..	N. P. Nielsen, Tiakita-huna	7 33	350·0	342	12,756·2	401·56
MILKING SHORTHORNS.						
Junior Two-year-old.						
Cloverlea Fillpail 2nd	D. Buick, Palmerston North	2 29	243·4	320	9,237·6	347·31
Senior Three-year-old.						
Matangi Ruth 2nd*	Ranstead Bros., Matangi	3 304	307·4	365	14,032·7	747·86
Junior Four-year-old.						
Matangi Nancy 2nd*	Ranstead Bros., Matangi	4 3	313·8	365	15,591·6	608·28
Mature.						
Studleigh Nancy Lee	D. Buick, Palmerston North	8 302	350·0	295	13,074·8	471·48
Studleigh Dairymaid	D. Buick, Palmerston North	..	350·0	274	11,020·1	414·43
Miss Massey A. ..	J. M. Whitham, Glenbrook	5 1	350·0	324	10,479·3	396·36
Pukerima Esta ..	John Fisher, Pukerimu	11 32	350·0	334	8,302·5	369·80
AYRSHIRES.						
Three-year-old.						
Dolores 2nd of Waipapa	Fred. Mills, Waipapa	3 358	312·8	365	11,755·8	497·80
Four-year-old.						
Dominion Parkhead Girl	Moumahaki Experimental Farm	4 353	348·8	365	10,985·2	423·00
Mature.						
Miss Gillies 1st of Inglewood* ..	R. S. Weir, Seaward Downs	..	350·0	335	13,171·0	541·63
Betty of Waipapa ..	Fred. Mills, Waipapa	9 218	350·0	365	13,260·7	532·33
Daisy of Greenbank*	W. Moore, Homebush	..	350·0	321	10,696·4	479·09
Glady's 2nd of Waipapa	Fred. Mills, Waipapa	9 173	350·0	365	11,610·2	414·74
RED POLLS.						
Two-year-old.						
Table Top ..	Central Development Farm, Weraroa	1 358	240·5	360	8,306·0	357·14
Dominion Suvla Bay	Central Development Farm, Weraroa	2 47	245·2	356	6,856·3	290·76
Three-year-old.						
Dominion Golden Flower	Central Development Farm, Weraroa	3 65	283·5	300	7,993·8	322·99
Mature.						
Sylph	Central Development Farm, Weraroa	8 45	350·0	335	11,252·2	468·40

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at starting Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

Second-class Certificates.

JERSEYS.

		Yrs. dys.	lb.		lb.	lb.
<i>Junior Two-year-old.</i>						
Bilberry's Golden Melody	W. J. Spooner, Awapuni	2 25	243·0	365	8,592·5	503·27
Silverdale Kildare ..	J. Doel, jun., Taumarere	1 339	240·5	365	8,553·5	457·97
Silverdale Golden Hope	G. Hodgson, Whakapara	1 284	240·5	354	5,977·9	370·03
Ensley Jewel ..	R. F. Wilkinson, Pukekohe	1 363	240·5	365	7,704·5	364·72
Fernaig Fruition ..	G. Welsby, Maungata-pere	1 352	240·5	320	5,255·5	303·45
<i>Senior Two-year-old.</i>						
Holly Oaks Favourite	M. V. Reeve-Smith, Aria	2 132	253·7	352	8,162·7	429·73
Holly Oaks Bonny ..	S. C. Colmore-Williams, Dargaville	2 209	261·4	353	6,549·3	374·03
<i>Three-year-old.</i>						
Laurel's Heroine ..	H. H. Sutton and Co., Longbush	3 336	310·6	365	9,740·6	490·35
<i>Mature.</i>						
Aparima ..	C. Stevens, Maungata-pere	6 318	350·0	365	10,289·6	574·20



BELLE OF FRIESLAND (C. H. STEADMAN, KAMO).

C.O.R., Friesian mature class: 21,519·4 lb. milk, 822·67 lb. butterfat, in 365 days.

A READY-RECKONER FOR WEIGHT OF FIELD CROPS PER ACRE.

(Continued from December.)

TABLE SHOWING WEIGHT OF CROP PER ACRE WHEN THE AREA FROM WHICH THE PRODUCE IS TAKEN IS 1 CHAIN IN 21 IN. DRILLS—EQUIVALENT TO $\frac{1}{377}$ ACRE.

Weight per Area.	Weight per Acre.	Weight per Area.	Weight per Acre.	Weight per Area.	Weight per Acre.	Weight per Area.	Weight per Acre.
lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.
1	0 3 1 13	61	10 5 1 15	121	20 7 1 17	181	30 9 1 19
2	0 6 2 26	62	10 8 3 0	122	20 10 3 2	182	30 12 3 4
3	0 10 0 11	63	10 12 0 13	123	20 14 0 15	183	30 16 0 17
4	0 13 1 24	64	10 15 1 26	124	20 17 2 0	184	30 19 2 2
5	0 16 3 10	65	10 18 3 12	125	21 0 3 14	185	31 2 3 16
6	1 0 0 23	66	11 2 0 25	126	21 4 0 27	186	31 6 1 1
7	1 3 2 8	67	11 5 2 10	127	21 7 2 12	187	31 9 2 14
8	1 6 3 21	68	11 8 3 23	128	21 10 3 25	188	31 12 3 27
9	1 10 1 6	69	11 12 1 8	129	21 14 1 10	189	31 16 1 12
10	1 13 2 20	70	11 15 2 21	130	21 17 2 23	190	31 19 2 25
11	1 17 0 4	71	11 19 0 6	131	22 1 0 8	191	32 3 0 10
12	2 0 1 17	72	12 2 1 19	132	22 4 1 21	192	32 6 1 23
13	2 3 3 2	73	12 5 3 4	133	22 7 3 6	193	32 9 3 8
14	2 7 0 15	74	12 9 0 17	134	22 11 0 19	194	32 13 0 21
15	2 10 2 1	75	12 12 2 3	135	22 14 2 5	195	32 16 2 7
16	2 13 3 14	76	12 15 3 16	136	22 17 3 18	196	32 19 3 20
17	2 17 0 27	77	12 19 1 1	137	23 1 1 3	197	33 3 1 5
18	3 0 2 12	78	13 2 2 14	138	23 4 2 16	198	33 6 2 18
19	3 3 3 25	79	13 5 3 27	139	23 8 0 1	199	33 10 0 3
20	3 7 1 10	80	13 9 1 12	140	23 11 1 14	200	33 13 1 16
21	3 10 2 23	81	13 12 2 25	141	23 14 2 27	201	33 16 3 1
22	3 14 0 8	82	13 16 0 10	142	23 18 0 12	202	34 0 0 14
23	3 17 1 21	83	13 19 1 23	143	24 1 1 25	203	34 3 1 27
24	4 0 3 6	84	14 2 3 8	144	24 4 3 10	204	34 6 3 12
25	4 4 0 20	85	14 6 0 22	145	24 8 0 24	205	34 10 0 26
26	4 7 2 5	86	14 9 2 7	146	24 11 2 9	206	34 13 2 11
27	4 10 3 18	87	14 12 3 20	147	24 14 3 22	207	34 16 3 24
28	4 14 1 3	88	14 16 1 5	148	24 18 1 7	208	35 0 1 9
29	4 17 2 16	89	14 19 2 18	149	25 1 2 20	209	35 3 2 22
30	5 1 0 1	90	15 3 0 3	150	25 5 0 5	210	35 7 0 7
31	5 4 1 14	91	15 6 1 16	151	25 8 1 18	211	35 10 1 20
32	5 7 2 27	92	15 9 3 1	152	25 11 3 3	212	35 13 3 5
33	5 11 0 12	93	15 13 0 14	153	25 15 0 16	213	35 17 0 18
34	5 14 1 25	94	15 16 1 27	154	25 18 2 1	214	36 0 2 3
35	5 17 3 11	95	15 19 3 13	155	26 1 3 15	215	36 3 3 17
36	6 1 0 24	96	16 3 0 26	156	26 5 1 0	216	36 7 1 2
37	6 4 2 9	97	16 6 2 11	157	26 8 2 13	217	36 10 2 15
38	6 7 3 22	98	16 9 3 24	158	26 11 3 26	218	36 14 0 0
39	6 11 1 7	99	16 13 1 9	159	26 15 1 11	219	36 17 1 13
40	6 14 2 20	100	16 16 2 22	160	26 18 2 24	220	37 0 2 26
41	6 18 0 5	101	17 0 0 7	161	27 1 2 9	221	37 4 0 11
42	7 1 1 18	102	17 3 1 20	162	27 5 1 22	222	37 7 1 24
43	7 4 3 3	103	17 6 3 5	163	27 8 3 7	223	37 10 3 9
44	7 8 0 16	104	17 10 0 18	164	27 12 0 20	224	37 14 0 22
45	7 11 2 2	105	17 13 2 4	165	27 15 2 6	225	37 17 2 8
46	7 14 3 15	106	17 16 3 17	166	27 18 3 19	226	38 0 3 21
47	7 18 1 0	107	18 0 1 2	167	28 1 4	227	38 4 1 6
48	8 1 2 13	108	18 3 2 15	168	28 5 2 17	228	38 7 2 19
49	8 4 3 26	109	18 7 0 0	169	28 9 0 4	229	38 11 0 4
50	8 8 1 11	110	18 10 1 13	170	28 12 1 15	230	38 14 1 17
51	8 11 2 24	111	18 13 2 26	171	28 15 3 0	231	38 17 3 3
52	8 15 0 9	112	18 17 0 11	172	28 19 0 13	232	39 1 0 15
53	8 18 1 22	113	19 0 3 24	173	29 2 1 26	233	39 4 2 0
54	9 1 3 7	114	19 3 3 9	174	29 5 3 11	234	39 7 3 13
55	9 5 0 21	115	19 7 0 23	175	29 9 0 25	235	39 11 0 27
56	9 8 2 6	116	19 10 2 8	176	29 12 2 10	236	39 14 2 12
57	9 11 3 19	117	19 13 3 21	177	29 15 3 23	237	39 17 3 25
58	9 15 1 4	118	19 17 1 6	178	29 19 1 8	238	40 1 1 10
59	9 18 2 17	119	20 0 2 19	179	30 2 2 21	239	40 4 2 23
60	10 2 0 2	120	20 4 0 4	180	30 6 0 6	240	40 8 0 8

TABLE SHOWING WEIGHT OF CROP PER ACRE—continued.

Weight per Area.	Weight per Acre.			Weight per Area.	Weight per Acre.			Weight per Area.	Weight per Acre.			Weight per Area.	Weight per Acre.		
lb.	Tons	cwt.	qr. lb.	lb.	Tons	cwt.	qr. lb.	lb.	Tons	cwt.	qr. lb.	lb.	Tons	cwt.	qr. lb.
241	40	11	1 21	319	53	14	0 7	397	66	16	2 21	475	79	19	1 7
242	40	14	3 6	320	53	17	1 20	398	67	0	0 6	476	80	2	2 20
243	40	18	0 19	321	54	0	5 5	399	67	3	1 19	477	80	6	0 5
244	41	1	2 4	322	54	4	0 18	400	67	6	3 4	478	80	9	1 18
245	41	4	3 18	323	54	7	2 3	401	67	10	0 17	479	80	12	3 3
246	41	8	1 3	324	54	10	3 16	402	67	13	2 2	480	80	16	0 16
247	41	11	2 16	325	54	14	1 2	403	67	16	3 15	481	80	19	2 1
248	41	15	0 1	326	54	17	1 15	404	68	0	1 0	482	81	2	3 14
249	41	18	1 14	327	55	1	0 0	405	68	3	2 14	483	81	6	0 27
250	42	1	2 27	328	55	4	1 13	406	68	6	3 27	484	81	9	2 12
251	42	5	0 12	329	55	7	2 26	407	68	10	1 12	485	81	12	3 26
252	42	8	1 25	330	55	11	0 11	408	68	13	2 25	486	81	16	1 11
253	42	11	3 10	331	55	14	1 24	409	68	17	0 10	487	81	19	2 24
254	42	15	0 23	332	55	17	3 9	410	69	0	1 23	488	82	3	0 9
255	42	18	2 9	333	56	1	0 22	411	69	3	3 8	489	82	6	1 22
256	43	1	3 22	334	56	4	2 0	412	69	7	0 21	490	82	9	3 7
257	43	5	1 7	335	56	7	3 21	413	69	10	2 6	491	82	13	0 20
258	43	8	2 20	336	56	11	1 6	414	69	13	3 19	492	82	16	2 5
259	43	12	0 5	337	56	14	2 19	415	69	17	1 5	493	82	19	3 18
260	43	15	1 18	338	56	18	0 4	416	70	0	2 18	494	83	3	1 3
261	43	18	3 3	339	57	1	1 17	417	70	4	0 3	495	83	6	2 17
262	44	2	0 16	340	57	4	3 2	418	70	7	1 16	496	83	10	0 2
263	44	5	2 1	341	57	8	0 15	419	70	10	3 1	497	83	13	1 15
264	44	8	3 14	342	57	11	2 0	420	70	14	0 14	498	83	16	3 0
265	44	12	1 0	343	57	14	3 13	421	70	17	1 27	499	84	0	0 13
266	44	15	2 13	344	57	18	0 26	422	71	0	3 12	500	84	4	1 26
267	44	18	3 26	345	58	1	2 6	423	71	4	0 25	501	84	6	3 11
268	45	2	1 11	346	58	4	3 25	424	71	7	2 10	502	84	10	0 24
269	45	5	2 24	347	58	8	1 10	425	71	10	3 24	503	84	13	2 9
270	45	9	0 9	348	58	11	3 23	426	71	14	1 9	504	84	16	3 22
271	45	12	1 22	349	58	15	0 8	427	71	17	2 22	505	85	0	1 8
272	45	15	3 7	350	58	18	1 21	428	72	1	0 7	506	85	3	2 21
273	45	19	0 20	351	59	1	3 6	429	72	4	1 20	507	85	7	0 6
274	46	2	2 5	352	59	5	0 19	430	72	7	3 5	508	85	10	1 19
275	46	5	3 19	353	59	8	2 4	431	72	11	0 18	509	85	13	3 4
276	46	9	1 4	354	59	11	3 17	432	72	14	2 3	510	85	17	0 17
277	46	12	2 17	355	59	15	1 3	433	72	17	3 16	511	86	0	2 2
278	46	16	0 2	356	59	18	2 16	434	73	1	1 1	512	86	3	3 15
279	46	19	1 15	357	60	2	0 1	435	73	4	2 15	513	86	7	1 0
280	47	2	3 0	358	60	5	1 14	436	73	8	0 0	514	86	10	2 13
281	47	6	0 13	359	60	8	2 27	437	73	11	1 13	515	86	13	3 27
282	47	9	1 26	360	60	12	0 12	438	73	14	2 26	516	86	17	1 12
283	47	12	3 11	361	60	15	1 25	439	73	18	0 11	517	87	0	2 25
284	47	16	0 24	362	60	18	3 10	440	74	1	1 24	518	87	4	0 10
285	47	19	2 10	363	61	2	0 23	441	74	4	3 9	519	87	7	1 23
286	48	2	3 23	364	61	5	2 8	442	74	8	0 22	520	87	10	3 8
287	48	6	1 8	365	61	8	3 22	443	74	11	2 7	521	87	14	0 21
288	48	9	2 21	366	61	12	1 7	444	74	14	3 20	522	87	17	2 6
289	48	13	0 6	367	61	15	2 20	445	74	18	1 6	523	88	0	3 19
290	48	16	1 19	368	61	19	0 5	446	75	1	2 19	524	88	4	1 4
291	48	19	3 4	369	62	2	1 18	447	75	5	0 4	525	88	7	2 18
292	49	3	0 17	370	62	5	3 3	448	75	8	1 17	526	88	11	0 3
293	49	6	2 2	371	62	9	0 16	449	75	11	3 2	527	88	14	1 16
294	49	9	3 15	372	62	12	2 1	450	75	15	0 15	528	88	17	3 1
295	49	13	1 1	373	62	15	3 14	451	75	18	2 0	529	89	1	0 14
296	49	16	2 14	374	62	19	0 27	452	76	1	3 13	530	89	4	1 27
297	49	19	3 27	375	63	2	2 13	453	76	5	0 26	531	89	7	3 12
298	50	3	1 12	376	63	5	3 26	454	76	8	2 11	532	89	11	0 25
299	50	6	2 25	377	63	9	1 11	455	76	11	3 25	533	89	14	2 10
300	50	10	0 10	378	63	12	2 24	456	76	15	1 10	534	89	17	3 23
301	50	13	1 8	379	63	16	0 9	457	76	18	2 23	535	90	1	1 9
302	50	16	3 8	380	63	19	1 22	458	77	2	0 8	536	90	4	2 22
303	51	0	0 21	381	64	2	3 7	459	77	5	1 21	537	90	8	0 7
304	51	3	2 6	382	64	6	0 20	460	77	8	3 6	538	90	11	1 20
305	51	6	3 20	383	64	9	2 15	461	77	12	0 19	539	90	14	3 5
306	51	10	1 5	384	64	12	3 18	462	77	15	2 4	540	90	18	0 18
307	51	13	2 18	385	64	16	1 4	463	77	18	3 17	541	91	1	2 3
308	51	17	0 3	386	64	19	2 17	464	78	2	1 2	542	91	4	3 16
309	52	0	1 16	387	65	3	0 2	465	78	5	2 16	543	91	8	1 1
310	52	3	3 1	388	65	6	1 15	466	78	9	0 1	544	91	11	2 14
311	52	7	0 14	389	65	9	3 0	467	78	12	1 14	545	91	15	0 0
312	52	10	1 27	390	65	13	0 13	468	78	15	2 27	546	91	18	1 13
313	52	13	3 12	391	65	16	1 26	469	78	19	0 12	547	92	1	2 26
314	52	17	0 25	392	66	3	0 11	470	79	2	1 25	548	92	5	0 11
315	53	0	2 11	393	66	6	3 24	471	79	5	3 10	549	92	8	1 24
316	53	3	3 24	394	66	9	2 9	472	79	9	0 23	550	92	11	3 9
317	53	7	1 9	395	66	13	1 23	473	79	12	2 8	551	92	15	0 22
318	53	10	2 22	396	66	16	3 8	474	79	15	3 21	552	92	18	2 7

TABLE SHOWING WEIGHT OF CROP PER ACRE—*continued.*

Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.
lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.
553	93 1 3 20	565	95 2 1 10	577	97 2 2 27	589	99 3 0 16
554	93 5 1 5	566	95 5 2 23	578	97 6 0 12	590	99 6 2 1
555	93 8 2 19	567	95 9 0 8	579	97 9 1 25	591	99 9 3 14
556	93 12 0 4	568	95 12 1 21	580	97 12 3 10	592	99 13 0 27
557	93 15 1 17	569	95 15 3 6	581	97 16 0 23	593	99 16 2 12
558	93 18 3 2	570	95 19 0 19	582	97 19 2 8	594	99 19 3 25
559	94 2 0 15	571	96 2 2 4	583	98 2 3 21	595	100 3 1 11
560	94 5 2 0	572	96 5 3 17	584	98 6 1 6	596	100 6 2 24
561	94 8 3 13	573	96 9 1 2	585	98 9 2 20	597	100 10 0 9
562	94 12 0 26	574	96 12 2 15	586	98 13 0 5	598	100 13 1 22
563	94 15 2 11	575	96 16 0 1	587	98 16 1 18	599	100 16 3 7
564	94 18 3 24	576	96 19 1 14	588	98 19 3 3	600	101 0 0 20

GREEN-MANURING TRIAL IN CANTERBURY.

MEANS of maintaining the organic matter in soils in Canterbury presents a constant problem to the farmer. The ploughing-in of crops specially grown for green-manuring purposes is an expensive method, and the results so far observed do not appear to have been generally remunerative. The crop rotations usually followed in the district provide for certain crops such as oats, rape, turnips, and short-rotation pastures being fed off, and thus the organic matter is to a degree maintained.

In order to ascertain if American sweet clover (*Melilotus alba*) would be of value for green-manuring purposes, a trial was arranged last season on the farm of Messrs. Collett Bros., Lyndhurst. Wheat was sown on somewhat light land in the autumn, and in the spring, when the wheat was being harrowed and rolled, adjoining strips were sown with 8 lb. of sweet clover and 4 lb. cow-grass per acre. The spring was dry and summer wet. In each plot a satisfactory germination took place. The wheat was harvested about the middle of January, and by the early autumn the cow-grass area showed a considerable amount of growth, while the sweet clover was thin and weak. During the winter and early spring the cow-grass provided an abundance of feed for sheep, but the sweet clover failed completely.

Apart from the amount of green manure available for ploughing-in in the spring, the autumn and winter grazing more than paid for the seeding in the case of the cow-grass. It must be noted, however, that without the high summer rainfall of 1922-23 the result might have been quite unsatisfactory in both cases.

—F. E. Ward, Instructor in Agriculture, Christchurch.

Control of Export of Apples to South American Markets.—By Order in Council gazetted on 20th December the exportation of fresh apples from New Zealand to Argentina, Brazil, and Uruguay is prohibited, except with the consent of the Minister of Agriculture.

SEASONAL NOTES.

THE FARM.

AUTUMN GRASSING.

As autumn approaches, preparation for required grassing must be taken in hand. Considering the results that are expected of a pasture, and the fact that in many cases, such as newly felled bush country, it will be impracticable to rectify mistakes subsequently, it is false economy to stint time, thought, or money in either the preparation of the land or the selection of a seed-mixture.

As regards the second point, too much emphasis cannot be laid on the fact that only those species should be sown that can be reasonably expected to succeed and form a turf sufficiently strong to keep out undesirable growths. To attain this end it is a sound plan to take each separate piece of land on its merits, rather than attempt to make a general mixture cover all requirements. On dry high-lying faces and knolls where the conditions are unfavourable to the better grasses danthonia, brown-top, Chewings fescue, and crested dogtail should be relied upon; Yorkshire fog and Lotus major should be included in mixtures for badly drained swamps or waterlogged land; rye-grass, timothy, and alsike suit the better classes of swamp and all good moisture-holding soils; cocksfoot and white clover do well on all bush-burns of fair quality; while paspalum should be used on areas in the North where dry, hot summers are experienced.

On arable land, as a general principle, it is not good practice to sow down to pasture after a grain crop, owing to the danger of grass-grub and the fact that the soil has been reduced in fertility. Pastures, particularly permanent pastures, should follow a fed-off crop like rape, turnips, or peas. It is recognized, however, that there are times on most farms when sowing to pasture after a grain crop cannot be avoided. In such cases the land should be ploughed as quickly as conditions will permit, and allowed to lie up to the weather, with the object of destroying weeds and giving the land the benefit of the sun. If there is sufficient moisture, sowing may take place about the end of February, but usually March will be early enough.

As regards actual sowing, this should be done as far as possible while rain is pending, more especially where surface-sowing is practised and the seed is left uncovered. On cultivated ground a hollow lumpy tilth is to be avoided at all costs, and rolling is generally advisable.

GREEN FEED.

Where it is intended to utilize the land for crops next spring it should be worked up ready for sowing down in a green crop as soon as weather conditions are favourable. This season, owing to the dry conditions that have prevailed, green feed will be in great demand,

but it is of no use sowing until there is sufficient moisture to ensure a good growth. For autumn feed nothing will come up to Black Skinless barley as regards quickness and quantity of feed, sown at the rate of $2\frac{1}{2}$ bushels per acre with 1 cwt. of super. If sowing oats, and quick feed is desired, Gartons or a similar white oat should be used. If, on the other hand, the feeding is not required until winter or early spring, Algerians are best, sown at from $2\frac{1}{2}$ to $3\frac{1}{2}$ bushels per acre with 1 cwt. super.

Another very useful catch-crop is rye-grass (either Italian or Western Wolths), sown at the rate of 20 lb. per acre, together with a few pounds of red (or crimson) clover and a bushel of Algerian oats. This will give both autumn and early spring feed, and possibly a cut of hay as well; but care should be taken not to use for this purpose any land that lies wet during the winter. Sown pure in February, Western Wolths will provide good green feed and a crop of seed in the following summer. A mixture of $1\frac{1}{2}$ bushels of winter vetches and $1\frac{1}{2}$ bushels of Garton oats is a suitable forage crop for early spring feed under Southern conditions.

Where the land is light and poor in humus, and the field can be spared, it may be sown down in white mustard at 10 lb. to 12 lb. per acre, to be turned under in about two months for green manure.

LUCERNE.

February is a good month for destroying grass and weeds on established areas, provided the land is soft enough to permit cultivation. If very hard it is best left alone until sufficient rain has fallen to soften the top three or four inches of soil. Young first-year crops should be ready for cutting this month. Cut just at the flowering stage, and give the land a stroke or two of the tine harrows or a light cultivation to destroy surface weeds and keep the soil free.

Lucerne should not be sown later than the end of February in Canterbury, owing to the danger from early frosts.

SUNDRY HINTS.

Where land has been fallowed all summer for the destruction of twitch it will be necessary during February to keep the team busy, taking advantage of the sunshine during that month, as in March the land should be deep-ploughed in readiness for autumn sowings. If the land is comparatively clean it can be used for the green-feed crop.

Land intended for autumn wheat should now be skim-ploughed as soon as possible, whether it be out of lea, rape, or stubble.

Intercultivation of turnips and other root crops should still be carried on where possible, as this operation conserves moisture and allows of the aeration of the soil.

Where wheat or other grain crops have been stacked the stuff should be left for at least six weeks, so as to let the grain regain its firmness after the usual sweat in the stack. It is sound economy to thatch—or at any rate cap—all stacks directly harvesting is over, otherwise there is always considerable risk of damage, however well the stacks are built. After harvest or haymaking, mowers and binders should be

carefully cleaned of dirt and grass-seed before being oiled and put away for next season.

In the making of stack ensilage a sheltered position should be chosen if possible for the stack, as difficulty is often experienced in attaining the necessary temperature in exposed situations during windy weather.

Water has been very short on many farms where no proper provision is made, and stock in a great many cases have felt the shortage of water more than the shortage of feed. On such farms all springs should be carefully watched and the water-flow measured during the present dry season for guidance in providing a proper water-supply in future. For dairy herds a good water-supply easily accessible is almost as important as good feed.

—*Fields Division.*

THE ORCHARD.

HARVESTING STONE AND PIP FRUITS.

THE harvesting of stone and pip fruits will now require constant attention. The work should be kept well in hand by going over the trees from time to time and picking all fruits which are ready. Grade at picking-time for maturity, but with due consideration for the market distance. With a large area to go over, particularly with a light crop or trees of low productivity, one is tempted to take the most opportune time and clear the trees at one operation, and grade for maturity later. This has one advantage—the crop is handled quickly; but, on the other hand, there are many disadvantages. Some fruits will have attained advanced maturity, while others are very immature; the labour of the whole harvest is rushed for a period; fruit which should be marketed immediately is held up unduly between the operations of picking and packing; and the marketable output is reduced considerably, due to the quantity of undeveloped fruit which has to be discarded.

It is a most difficult matter to describe in words the correct stage at which to pick fruit, so much depends on the purpose for which the fruit is required. Tree maturity is always a stage ahead of store maturity for quality; therefore to obtain the best quality of fruit required for marketing immediately after picking, such fruit may be allowed to remain on the tree to a much more matured condition than would be the case for fruit required for storing for later markets. There is a point in the maturity of fruit below which picked fruit will wilt and shrivel, or above which picked fruit will mature gradually according to the storage.

Extensive experiments have been conducted to try and determine as near as possible what condition indicates this point, so that the full storage life may be used to advantage. The ground-colour has so far been found the best guide, though not in all instances reliable, as ground-colour characteristics differ according to district quite as much as blush colour. It may be taken as a principle that no fruit

is ready for picking unless its leaf-green ground-colour has taken on a yellowish tinge; by this time the blush colour also is usually well pronounced and changing from dullness to a bright attractiveness.

When picked all fruit should be removed as soon as possible to a cool place or well shaded from the sun. Once off the tree the fruit-pulp rapidly takes on the atmospheric temperature. At picking-time this is usually many degrees above tree-fruit temperature, and exposure results in rapid expansion of the fruit-cells and sweating. Any such rise in flesh temperature will restrict the keeping-period very materially, and is a primary cause of many storage defects.

CODLIN-MOTH.

This is the season of the year when the second brood of codlin-moth can be expected. Most orchardists are well acquainted with the so-called "moth-stings" found at picking-time. These are really the result of the moth-grub having eaten a portion of the skin and tissue before the arsenate has taken sufficient effect to kill it. The spring brood of codlin-grubs feed for a while on the minute hairs covering the fruit, and this affords a good opportunity to kill them before they have damaged the fruit-surface. Now that the fruit has outgrown the downy stage, grubs attack the skin immediately they commence to feed.

In order to ensure an immediate kill, the deposit of arsenate should be kept as fresh as possible. Twenty-one-day intervals are usually regarded as sufficiently often to make the applications, yet the emergence of summer grubs is so irregular and the risk of blemish from their attack so great that the January sprays, at any rate, may with advantage be applied at fourteen-day intervals. Stronger arsenate is sometimes recommended, but experiments indicate that this is not nearly so important as maintaining the usual strength of arsenate in fresh condition. It is not unusual to experience heavy falls of rain during January, and moth-stings are usually more abundant in a crop following such rain, indicating that the spray is nullified to a great extent when washed by rain.

LEAF-ROLLER CATERPILLAR.

These constant applications of arsenate of lead at $1\frac{1}{2}$ lb. per 100 gallons will also assist towards eradicating leaf-roller caterpillar. A very necessary factor in the spraying for leaf-roller is high pressure. At this season many orchardists adjust the nozzles of the rod or gun to produce a very fine mist-like spray, on the assumption that a light deposit is all that is necessary. The habits of leaf-roller are such that this reduced volume of spray is of low value in control, as it does not penetrate the rolled-up leaf or separate the leaf adherent to the fruit; consequently there is no arsenate deposited on the immediate surroundings of the grub. If leaf-roller is present on the trees a much better spray job can be done with a good pressure and a rather coarse nozzle.

APPLE LEAF-HOPPER.

A summer brood of apple leaf-hopper may be expected. Whenever a spray is due, examine the under-sides of the foliage for the nymphs

of this pest. These will be found as a light-green to yellow insect settled along the midrib of the leaf. They later develop into winged insects. In the early stages they are easy to kill. Black Leaf 40, 1-800, gives very satisfactory results; but if remedial measures are not taken promptly, and the insect develops into the winged state, eradication is almost impossible. The damage done by these insects is considerable. The withdrawal of quantities of sap from the tree restricts fruit-development, and the devitalization is such that it is almost impossible to build up mature wood and buds for next season. Trees not in crop must therefore be protected for future years. The excrement of the hopper causes disfigurement of the fruit and collects dirt on the sticky surface.

OTHER SEASONABLE WORK.

Other seasonable orchard-work will include cultivation, sowing of cover-crops, budding, and continuation of spraying as outlined in the December *Journal*.

—W. H. Rice, *Orchard Instructor, Hastings*.

CITRUS-CULTURE.

The maintenance of efficient cultivation and the application also of bordeaux mixture for the control of fungous diseases will be the main work during the coming month. The further spray of bordeaux, 4-4-40, should now be given. Where efficiently applied this compound not only controls verrucosis, but will to a great extent assist in the control of brown-rot, which is so often in evidence among citrus groves at this period of the year.

FIREBLIGHT.

Fortunately, fireblight is less pronounced this season than formerly, although it has made its appearance to some extent in the Auckland commercial-fruit area. It is, however, gratifying to note that it has been efficiently dealt with in most cases, though in two instances where apple-orchards were badly infected the occupiers so neglected to carry out efficient control measures that the Department found it necessary to enter and do the work at their expense. Although the Department's officers are always willing to assist, as far as opportunity permits, in the identification, &c., of the disease, it must be distinctly understood that the onus rests upon the occupier himself to see that his trees are kept free from fireblight infection.

A thorough inspection of all orchards in the infected areas is to be made at an early date, and those growers whose orchards are found to be infected will receive a short-term notice to comply with the provisions of the Orchard and Garden Diseases Act. Failure to comply will not only render them liable to prosecution and upon conviction to a fine up to £20, but will make it necessary for the Department to enter and do the work at their expense.

It is well here to remind growers in localities where fireblight has not yet been known to exist that if they notice any suspicious symptoms on their trees they should immediately notify the local Orchard Instructor.

—J. W. Collard, *Orchard Instructor, Auckland*.

POULTRY-KEEPING.

THE PULLETS.

Now that many of the pullets are half-grown it is obviously a time when they should be fed and handled with the greatest of care. The object should be to keep them steadily growing in the most natural way possible. In this respect a good range, preferably on clean ground, will do much for their proper development. Small runs, especially where the ground is stale, are not conducive to healthy growth.

The food supplied at this stage is most important. The ration should chiefly consist of sound grain materials in which good plump oats are included. This, together with an abundance of green material, grit, and clean water, is practically all they require. During the earlier chicken stage a good supply of animal food, such as meat, milk, &c., may be fed to advantage, but with the half-grown bird it should be fed with caution, or probably it will have the effect of forcing the birds to lay at too early an age. This condition should be avoided wherever possible, as it usually results in diminutive-sized specimens and layers of small eggs. It is not generally realized by poultry-keepers that once a pullet commences to lay she grows little, if at all, afterwards. Further, such birds never make desirable breeding-stock, however well they lay.

The small egg is one of the most striking weaknesses in connection with the industry to-day, and it is not the bird that develops prematurely that will correct matters in this respect. The aim of the breeder should be to attain the desired size in his stock before the productive period commences. In a general way, even with such early maturing breeds as the White Leghorn, the pullets should not commence to lay before they are at least six months old, in order that they may grow to the necessary size, possess the requisite constitutional vigour, and produce a good-sized egg.

The growing birds should not on any account be overcrowded, or trouble may be expected by way of vermin and disease. The profits to be made from poultry largely depend on the management the birds receive during all stages of their development. Any set-back received during the growing-period is never caught up.

LEG-WEAKNESS IN COCKERELS.

This is one of the many troubles affecting poultry which prevention is the only way of fighting. It is usually caused through insufficient exercise and the overfeeding of forcing-foods such as meat, milk, &c. A common mistake made by many poultry-keepers in connection with this trouble is that they select the most promising cockerels in the flock for future breeding purposes, and then place them in small runs, coops, &c. In order that they may make special growth they then provide them with plenty of rich nourishing food and special care and management. A much better plan would be to let such birds take their chance with the ordinary flock. It stands to reason that feeding rich foods to a bird during the growing stage and

curtailing its exercise will have the effect of encouraging size of body beyond that which the undeveloped legs are capable of carrying.

The growing cockerels intended for breeding should have ample range under the most natural conditions possible so that they may develop in a natural way. Where such range is not available the birds should be compelled to exercise by providing ample litter and feeding the grain foods in it. Once a cockerel becomes weak in the legs it will never make a high-class sire, as this indicates that it has an hereditary weakness or that its stamina has been weakened by improper management. Of course, where birds are to be marketed at the right age—at about four and a half months old—and in a prime condition, forcing-food as well as confined quarters are necessary so that they may make the greatest growth possible in the shortest space of time.

Very often in the case of the heavy-combed breeds, such as White Leghorns, Minorcas, &c., leg-weakness is accompanied by falling-over of the combs. This is usually another indication of a weakened constitution, due either to an hereditary taint or to the bird being over-supplied with rich food, or by having a restricted space for exercise. Young male birds are here referred to, as sometimes a falling-over comb may be brought about at a later stage, even with the strongest of birds, by a parasite attacking the comb. Its presence is usually indicated by a yellow incrustation on the blade of the comb, which gradually increases in size and penetrates to such an extent that the comb falls over. For treatment dissolve one chinisol tablet in half a breakfast-cup of water and sponge the affected parts. If this is done when the trouble is first noticed it will soon disappear. On the other hand, if it has reached an advanced stage the only safe course is to remove the comb by means of a pair of sharp scissors. In order to prevent bleeding, a good dressing of fuller's earth should be applied to the cut parts. With birds it is intended to show, the comb should be frequently examined in order to make sure that it is not being attacked by this parasite, many a good bird having been made useless for show purposes from no other cause.

CLEAN GROUND ESSENTIAL.

I would again urge the importance of turning over every run possible, and sowing it down with a suitable green material before the season becomes too late. Such a run will make an ideal place for next season's young stock after they leave the brooder. Chickens will always develop much more rapidly on such ground than on runs which have become stale. Not only this, but the green food thus grown will prove a valuable asset during the off-season of the year. Clean ground, especially for the young birds, is one of the secrets of successful poultry-keeping, and the man who makes ample provision for this will be amply rewarded in the long-run for his trouble.

One of the worst drawbacks to stale ground is that the young birds are always liable to become infested with disease and intestinal parasites, particularly round worms. Many poultry-keepers are of the opinion that none but the adult stock suffer as a result of these parasites, but this is not the case. Cases have recently come under my notice where chickens not more than six weeks old suddenly ceased to thrive,

and many deaths took place from no other cause. Needless to say they were confined in stale runs which had previously accommodated adult stock over a period of years. The latter may do fairly well when these parasites are present, but in the case of young birds the affected cases mostly prove fatal.

It will thus be seen that the importance of having two runs to each house, allowing the birds access to them alternately, and enabling them to be frequently turned over and sown down, can scarcely be over-estimated. Were this system of laying out plants more generally adopted many of the troubles due to "poultry-sick" ground would be unheard of. It must be admitted that where the soil is specially suitable for fowls (a sandy loam) they may remain more or less healthy even if the runs are not given a rest, but, generally speaking, neglect in this direction will usually result in the long-run in the production of weedy and unprofitable stock.

—F. C. Brown, *Chief Poultry Instructor.*

THE APIARY.

EXTRACTING.

EXTRACTING should now be in full swing in all districts of the Dominion. Where operations for any reason have been delayed care must be taken to see that the bees are not crowded out, or they will commence to loaf, and the ultimate crop will be small. It is a good policy to extract twice during the season, but where the beekeeper prefers to leave the work until the end of the flow a close watch should be kept so as to provide ample room. This, however, can only be done where large numbers of spare combs are kept on hand. It is during the season when honey is coming in freely that the beekeeper realizes that his most valuable asset, next to his bees, is a good stock of extracting-combs. Every effort should be made to get at least twenty spare combs for each hive in the apiary, and with this number always on hand the bees are not likely to be hampered for room. In the absence of plenty of drawn-out combs the best plan is to keep the extractor going, and thus prevent the bees from blocking the brood-combs. This usually happens unless ample room is provided, and as a result the queens are prevented from laying to their utmost, and the colonies dwindle. At no time during the working season should the work of the queen be hindered. Care must be taken at all times to see to this important item during the flow. The honey is quite ready to extract when the combs are three parts capped, but great care must be exercised not to extract unripe honey. Numerous instances have come under my notice where the practice of taking unripe honey has meant a total loss to the beekeeper.

Removing Honey from the Hive.

The usual practice followed when the time for extracting is at hand is to remove the frames one by one. If excluders are used much time will be saved in picking over the combs. As the combs are

taken from the hive, shake the bees in front of it, brush off the remaining bees, and place the combs in a super for removal to the honey-house. The combs should be covered with a cloth which has been previously placed in water containing a small percentage of carbolic acid. When the season is at its height very little trouble will be experienced from robbers, but in case of a stoppage in the flow this precaution is necessary. At all times the beekeeper should study his working equipment, and this is highly important when removing the honey. It will be found convenient to provide a good barrow or truck for carrying at least two full supers. Much time and labour will be saved, and the tedious work of removing the honey will be facilitated.

Uncapping.

One of the most important processes in the work of extracting is that of uncapping. There are several kinds of knives for the purpose on the market, but the stiff-bladed double-edged Bingham is usually first favourite. Two of these are necessary, and they must be stood in a pan of water which is kept boiling on a small lamp. Each knife as it becomes cold is returned to the boiling water, and the hot one takes its place. Any contrivance which is used for an uncapping-can should be provided with a cross-bar, through which to pass a screw or similar article, driven point upwards, to form a pivot on which to rest and revolve the combs. The comb should be placed with one end resting on the pivot and tilted slightly forward in order to allow the cappings to fall away from the comb. Uncapping should commence at the bottom of the comb and proceed with a sawing motion from side to side until the top is reached. The comb is then swung round on the pivot, and the reverse side treated in the same manner. Only a thin sheet of wax should be removed, but it must be done thoroughly so that every cell is opened, and at the same time the top and bottom bars should be relieved of any burr-combs which may adhere to them.

A contrivance much in favour with progressive beekeepers is the steam-heated knife. This is a Bingham knife with a soldered copper plate, so arranged that steam is forced through it from a rubber tube attached to the spout of a "bronchitis" kettle. An escape tube is fitted to the opposite side, and the knife is kept at a very high temperature all the time uncapping is proceeding, thereby obviating the work and trouble of continually plunging the knives into boiling water. For uncapping heavy fully capped frames it has no equal, as an ordinary uncapping-knife becomes cold as a rule before half one side of a full comb has been uncapped. The cappings should be left to drain for two or three days, after which time they should be gathered and melted.

Strainers.

It is not uncommon to find exposed for sale honey with which proper care and attention have not been paid to straining at the time of extracting. Nothing deters the sale of extracted honey so much as a layer of wax-particles, dead bees, &c., and it is surprising how few beekeepers take the necessary trouble to see their product reaches the customer free from wax and other impurities. In no case should honey be run direct from the extractor into the containers, but should be properly strained. It is the attention paid to this necessary

detail that aids in the sale of the crop, and when honey is properly treated it readily commands a higher price. Fine-gauge wire strainers are usually adopted, but even these are not sufficient to remove the smaller wax-particles. In order to ensure perfect condition the honey should be passed through good fine cheesecloth before being run into the tank. Cheesecloth strainers are excellent, cheap, and are easily made, while at the same time they can be readily cleansed. They remove everything but the smallest particles of wax, which should be finally disposed of when the honey is skimmed. This latter process is an important one, and should always be carried out before the honey is put up in marketable form.

Testing Honey for Ripeness.

Before tinning off the honey make certain it is ripe. Fermentation is sometimes quite a serious problem to the beekeeper, and yearly large quantities of honey which were thought to be well ripened at extracting-time ferment, more especially when left over till the weather becomes warm. The bulk of the honey produced in New Zealand is exported, and a matter of first importance is its condition on arrival at the overseas market. Usually beekeepers experience little difficulty with low specific-gravity honeys if care is exercised and only well-sealed combs are extracted from. However, to ensure that the honey is up to standard it should be tested with a hydrometer before being run into the tins. When making the test the contents of the tank should be gently paddled in order that the honey may be of the same consistency throughout. This operation is of importance, as there is always a risk of variation of the specific gravity of the honey at the bottom and top of the tank. If on testing with a Twaddell's No. 4 hydrometer the instrument does not sink below 84 a well-ripened honey is indicated. This is equal to a specific gravity of 1.42, the test being made at a temperature of 60° F. As the temperature of honey in the summer rarely sinks so low, the test may be taken at 70° or 80° by adding 1 point to the hydrometer-reading for each 10 degrees of heat over 60°. Thus, if the hydrometer sinks to 82 at a temperature of 80°, it would register 83 if taken at 70°, and 84 if taken at 60°. To arrive at the specific gravity multiply the hydrometer-reading by .005. Thus $84 \times .005 = .420$; add 1 for the specific gravity of water, and it will equal 1.420. This method is only reliable up to a temperature of 90°.

Testing Thick Honey.

Sometimes the honey is so dense that the hydrometer will not sink. When such is the case take equal parts by volume (not weight) of honey and water, mix thoroughly, test with a No. 2 Twaddell's hydrometer, and then multiply the result by 2. This will give the same result as if taken with a No. 4 instrument by the direct method. Thus, if the No. 2 instrument sinks into the honey and water to 42, this multiplied by 2 = 84. Perhaps the quickest and simplest method for testing thick honey is to have a deep glass or beaker on which is a mark to contain about 4 oz. of water. Fill up to the mark with water, then pour it into another vessel; now fill up to the mark with liquid honey, add the water previously measured, and mix thoroughly; then place in it the No. 2 hydrometer, note the number to which it sinks, and multiply

by 10; place the decimal point before the result, and add 1. Thus, if it registers 43, $43 \times 10 = 430$; place the decimal point before the $430 = .430$; to this add 1, which is the specific gravity of water, and the result will be 1.430.

—E. A. Earp, Senior Apiary Instructor.

THE GARDEN.

VEGETABLE-CULTURE.

THE winter crops should now be well established. Apply a dressing of nitrate of soda to cabbage, broccoli, and celery, and so make the most of the autumn growing season.

The tomato harvest will now be at its height where the crop is grown outside. On some dry areas water and chemical manures will be required to help the plants finish well.

As the onion, garlic, and shallot crops ripen, lift them and dry them well in the open before storing.

When lifting early potatoes keep the tubers from some of the best roots for seed, place them in shallow trays, and store in a light, airy shed.

Continue to sow salads and quick-maturing vegetables. Care should be taken to pull weeds before they seed, more especially the taller kinds.

SMALL FRUITS.

Dry weather has checked the growth in some strawberry-gardens; a dressing of superphosphate, sulphate of potash, and sulphate of ammonia applied now and harrowed in will bring the plants along with the autumn rains. Four years is about the life of a strawberry plantation, and sections to follow on should be prepared in good time. It is necessary to have the land clean and in good heart before planting this crop.

Cape gooseberries that are backward may likewise be dealt with manually as recommended for strawberries.

Those wishing to grow passion-fruit should sow the seeds now, so that the plants will be ready for putting out in early spring.

FLOWERS AND LAWNS.

The same attention with regard to weeding is required in the flower-garden as in the vegetable section; it is sound economy to prevent weeds seeding.

The season for garden-making is at hand, and any plans for such work should be speedily completed. Many plans are too ambitious and beyond the resources of the gardener. It is wise to err on the side of simplicity and to keep the scope well within the time that can be devoted to this special work. In a garden, as elsewhere, quality is better than quantity, and will undoubtedly give greater satisfaction. The amount of work in a garden does not depend on mere size, but more on the extent of the flower-borders, and even there the work can be lessened and results improved by larger grouping.

Lawn-grass seed is best sown during the month of March, so preparations should be completed without delay. Besides cleaning the land and working it to a fine tilth, time is required to let it settle, and so avoid those potholes that are so disfiguring on a lawn that is hastily laid.

In the garden nature compels one to take a very long view. Work has to be planned six or twelve months ahead, and many chances taken; compromises and makeshifts are not effective; on some points nature is not to be coerced. One of the secrets of success is the compost heap—a heap of soil mixed and prepared, and allowed to mellow one or even two years before it is used for seed-boxes and potting. Its composition varies, naturally, under different circumstances, but the main ingredients should be six parts turfy loam, two parts well-decayed manure—say, from an old hotbed—and one part of good sharp sand. Other organic manures are sometimes used, including bonedust, or the slower and more lasting chemical fertilizers such as basic slag. Turned occasionally to allow fungi and seed weeds to exhaust themselves, this rich mound of open texture gives seedlings and cuttings an excellent start, and makes pot-plant culture a pleasure and a success. If not already prepared, it should be got ready now for the spring work.

Spring flowering bulbs should now be planted without delay; they like a rich soil with an abundance of humus. The common impression that they do not like manure is incorrect, but it must be well rotted. Planted in the grass or on the edge of shrubberies in rather large masses they are effective during winter and spring, and require very little attention.

Seeds of any or all of the following important biennials and perennials should be sown now for flowering next spring and summer: Pansies, stocks, wallflowers, ranunculus, primroses, polyanthus, hollyhocks, cineraria, antirrhinum, aquilegia, anemones, nemesia, and sweet-peas. The finer seeds are best started in boxes; benzine tins or cases may be adapted, and are then most suitable for the purpose. Place the most fibrous portions of the compost in the bottom of the box, and fill up with soil to within nearly half an inch of the edge; press it down firmly; sow the seeds; then with some soil in the sieve shake on them a light covering, and with a small piece of board press the surface firm and even. The smaller seeds may be given a very light coating of sand instead, and covered with a sheet of glass to prevent evaporation until germination has taken place. Place them in an open frame where they may be shaded from the hot sun and sheltered from heavy rains. Water with great care during early stages of growth.

Carnations may be layered. The operation known as "budding" may also be done during February.

—William C. Hyde, Horticulture Division.

Noxious Weeds.—The Ohinemuri County Council has declared fennel, gorse, and ox-eye daisy to be noxious weeds within that county.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TATTOOING EAR-MARKS.

"TATTOO," Waimate :—

I should be obliged if you would inform me what is the best method of and medium for tattooing ear-marks on a pedigree herd. I have been using Indian ink with a perforating ear-marker made by Maw and Son, of London. I rubbed the pricking-points with Indian ink, and then rubbed more into the wounds, but am not satisfied with the result. The stain is feeble. Would gunpowder be better?

The Live-stock Division :—

The ear-marker mentioned by you should give satisfaction, provided care is taken in its use. The ear should first be cleaned with a little petrol to remove the grease. The marking-ink should then be rubbed over the area to be marked before making the perforation, and again after the instrument has been used. The ink should be of good quality, and be well rubbed in. It is recommended that sticks of Indian ink be used (obtainable from any large stationer at about 9d. each). Old black gunpowder may, however, be employed.

NITRATE-OF-SODA SOLUTION AND ANIMALS.

G. W. MILLER, Whangarei :—

Will you kindly inform me if nitrate of soda is poisonous to animals, as I have lately lost two cats? They were sick for about a week, and seemed to be in great pain. They had been accustomed to drinking out of the watering-can which I used for my pot-plants, and when I started using the nitrate of soda they still drank out of the can, and within two or three weeks they were both dead. I do not know of anything else that could have hurt them.

The Chemist :—

Nitrate of soda is certainly poisonous when taken in excessive doses, the symptoms being gastro-intestinal irritation, trembling, convulsions, tetanic convulsions, dilation of the pupil, and paralysis of the voluntary movements. The accumulation of nitrates in mangolds gives rise to poisoning of stock fed on them, unless the mangolds are pulled and the nitrates eliminated on storage by being transformed into other compounds. A case of this was recorded by the writer in the *Journal* for September, 1911. The solution of nitrates used for watering plants should certainly be kept out of reach of all animals.

HOME-MADE BUTTER.

"NEW SUBSCRIBER," Matawai :—

In making home-made butter from separated cream is it better to use the fresh cream, or leave it to ripen? If the latter, what time should the cream be held, and at what temperature should it be stored?

The Dairy Division :—

Butter made from sweet cream will retain its quality longer than if made from ripened cream. The flavour, however, is not so full. To make butter from sweet cream, the cream should be cooled directly it leaves the separator to a temperature of 60° F., and then let stand for at least four to six hours so as to allow the fat-globules to become completely cooled before churning. If the cream is to be ripened it should be let stand at the same temperature for from twenty to forty-eight hours longer to allow a slight degree of sourness to develop.

FEEDING SKIM-MILK TO PIGS.

C. POLAND, Paeroa :—

Is it better to feed skim-milk fresh or curdled to pigs ?

The Live-stock Division :—

Skim-milk should be fed fresh—that is, a few hours after separating—allowing all gases to escape. A good plan is to separate at night and feed milk in the morning, and *vice versa*. If the milk is allowed to remain in barrels to sour and curdle there is a danger of infection by undesirable germs. It is wisdom on the feeder's part to protect his pigs and prevent them from acquiring ailments which in the end prove very costly.

SOWING WATTLE-SEED FOR HEDGE.

H. J. WEEKS, Wanganui :—

When is the best time to sow wattle-seeds (*Acacia verticillata*), and should they be sown in nursery beds or where they are required? They are intended for a fence.

The Horticulture Division :—

The best time for sowing wattle-seed is in the spring. For the purposes of a hedge it may be sown where required. Clean and cultivate a good wide strip, giving a liberal dressing of bonedust before sowing.

COWS AND SHEEP BLOWN ON CLOVER.

WAKELIN, Winchmore :—

Could you inform me of the most simple method of dealing with cows and sheep which are blown on clover? What is your opinion regarding drenching for blown cattle ?

The Live-stock Division :—

The cause of bloating is the abundant ingestion of easily fermenting food, the most dangerous being clover, lucerne, mangolds, &c. To prevent bloating, animals should be permitted to pasture on clover-fields only after they have received some dry feed or have been fed on less luxuriant pasture, so that they will not partake of too much of the juicy fermentable food. The effect of bloating is that the gases formed tend to carry the rumen (first stomach) upwards, thereby closing the natural opening of the oesophagus by kinking the gullet, thus preventing the gases being belched up. Treatment should be as follows: First, raise the fore part by standing the animal uphill, or on a strong board placed on a bundle of straw, &c., sufficiently high to bring the opening into the rumen to the highest part. Second, draw the tongue out and at the same time irritate the back of the throat by the hand or a soft piece of rubber (a gag may be used for this). Third, massage the rumen by moderate pressure with both fists on the left flank. Surgical treatment should only be attempted after the above has failed or in a case of emergency. If this becomes necessary, and if time permits, the place should be clipped and painted with tincture of iodine, and after sterilizing the instrument it should be inserted at the highest point of the swelling on the left side, directing its point towards the right elbow. Too much gas should not be permitted to escape at once, otherwise collapse may occur, due to rupture of the blood-vessels by the sudden inrush of blood. Sheep will respond to the same treatment, but if large numbers are affected relief is often obtained by driving the sheep uphill or into a river, the latter causing contraction of the rumen. We are of opinion that the drenching of blown cows is unnecessary, but the following tonic may be given in a little gruel to a full-grown cow: Nux vomica, 1 oz.; pulverized aloes, 1 oz.; pulverized gentian, 1 oz.

FEEDING LOOSE SALT TO SHEEP.

"O. M. S.," Ashburton :—

I have been giving my sheep loose salt and mixing some stomach-tonics with it. I find it answers very well, but the sheep are eating it in fairly large quantities instead of licking it. Can you tell me anything I could mix with it or do to it to make it into blocks or licks?

The Live-stock Division :—

We cannot recommend the feeding of loose salt to sheep, as it is impossible to keep it in block form, and bad results have followed its use. Rock salt placed in suitable places is much preferable.

OAT-HUSKS AS STOCK-FOOD.

"COCKATOO," Henderson :—

Please inform me whether the husks obtainable from grain-mills are suitable for horse or dry-stock feed if crushed oats are added. Is there as much nutriment in the husk as in the straw of the oat?

The Live-stock Division :—

The husk does not contain as much nutriment as either the straw or the oat. It has the further disadvantage of being less digestible. It is sometimes fed with other foodstuffs in order to make bulk, and if fed with oats to horses it makes them chew the oats better. Further than this it is of little use.

HEIFER WITH LEAKY TEATS.

G. W. L. PALMER, Te Kuiti. -

I have a heifer that loses a quantity of milk each day through its running away from each quarter. She is milked regularly every day at about 5 in the morning and about 3 in the afternoon. I would be obliged if you could inform me of any safe treatment.

The Live-stock Division :

This condition is almost invariably due to the small muscular fibres (known as the sphincter) in the cow's teat, which normally act as a compressor of the teat when the quarter is distended, failing to contract, and thus allowing the milk to escape. There is no safe treatment to remedy this defect. Many appliances are sold for the purpose—such as rubber rings, teat-compressors, &c --but they are unsatisfactory and eventually injure the delicate lining of the milk-duct. Milking the heifer three or even four times daily might be tried, and in this way the teats might after a while develop the lacking function.

PURE SEED WHEAT.

PURE seed wheat is often difficult to secure in New Zealand, and the Department of Agriculture, in conjunction with the Canterbury Agricultural College authorities, is this season doing all possible to ensure that pure seed is available for next season's sowings. A certain amount of pure seed will be available from the College Farm, but the quantity will fall far short of the amount required for seed purposes in Canterbury and North Otago next season. To make up this shortage in some degree the Department has arranged for the inspection of the present wheat crops of those farmers who bought pure seed wheat from Canterbury Agricultural College Farm last year. Those farmers whose crops are, after inspection, found to be free from foreign varieties will be given a certificate to that effect.

WEATHER RECORDS : DECEMBER AND CALENDAR YEAR 1923.

Dominion Meteorological Office.

GENERAL SUMMARY FOR DECEMBER.

SUMMER weather conditions set in very early this season, and December was, on the whole, hot and dry. Westerly winds prevailed, as in November, and no ex-tropical disturbances were experienced—the opposite of last summer, when easterly winds and ex-tropical disturbances ruled. The rainfall, therefore, has been deficient in the east-coast districts.

Anticyclonic conditions, with almost general drought, ruled in the North during the first half of the month, while there were three westerly depressions of moderate intensity passing in the South, affording scattered but much appreciated rainfall. During the latter part of the month four—and these more intense—westerly low pressures passed in the South, and also accounted for scattered rainfall in the North. They were, however, more notable for the high westerly winds and boisterous conditions which ruled, particularly in and southward of Cook Strait. The north-westerly storm which occurred on the 28th was of great force, and caused damage in the Canterbury Plains.

Hot and dry weather was experienced in the east-coast districts, and warm and humid conditions generally during the month. Rainfall was again deficient on the east coast, especially of the North Island, hardly any rain falling between East Cape and Castle Point. Only 5 points (0.05 in.) were recorded at Napier, and 11 points at Maraekakaho Station, near Hastings. Only 14 points were recorded at the latter station in the previous month, and this is the record dry two-monthly period there for thirty years. The best and most general rains occurred about the 19th and 20th. Some stations on the west coast of the North Island—for example, Inglewood and Foxton—showed total rainfalls slightly over the average, and rainfalls above the average were also experienced in Westland and parts of Otago; elsewhere the falls were from 30 to 98 per cent. below the average of the same month in former years.

—D. C. Bales, Director.

RAINFALL FOR DECEMBER AND CALENDAR YEAR 1923 AT REPRESENTATIVE STATIONS.

Station.	December.				Calendar Year.	
	Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Total Rainfall, 1923.	Average Rainfall.
<i>North Island.</i>						
	Inches.		Inches.	Inches.	Inches.	Inches.
Kaitaia	2.25	4	1.15	3.28	71.72	50.87
Russell	0.85	5	0.54	2.05	53.31	47.11
Whangarei	1.32	6	0.34	2.49	54.02	61.10
Auckland	2.01	12	1.08	2.82	49.09	43.85
Hamilton	2.86	11	1.70	3.68	50.68	49.72
Kawhia	2.29	11	0.50	3.21	51.53	52.70
New Plymouth ..	3.04	13	0.63	4.28	62.64	59.95
Inglewood	8.08	11	1.43	7.72	95.75	104.45
Whangamomona ..	5.07	15	0.92	5.98	72.84	80.15
Tairua, Thames ..	0.87	4	0.56	4.30	58.03	65.82
Tauranga	2.12	7	1.63	3.39	62.78	51.95
Maraekakaho, Opotiki ..	1.32	5	0.68	2.82	57.01	50.77
Gisborne	0.13	3	0.08	2.13	47.88	46.96
Taupo	0.18	3	0.10	3.66	44.01	45.26

RAINFALL FOR DECEMBER AND YEAR 1923—*continued.*

Station.	December.				Calendar Year.	
	Total Fall.	Number of Wet Days.	Maximum Fall.	Average December Rainfall.	Total Rainfall, 1923.	Average Rainfall.

North Island—continued.

	Inches.		Inches.	Inches.	Inches.	Inches.
Napier	0·05	..	..	2·30	..	36·50
Maraekakaho, Hastings	0·11	4	0·06	2·17	37·83	34·77
Taihape	1·26	12	0·30	3·43	41·36	40·18
Masterton	0·89	9	0·23	2·57	41·75	38·71
Patea	2·13	13	0·53	3·35	46·19	44·05
Wanganui	1·12	5	0·60	2·63	28·75	37·26
Foxton	3·39	8	1·45	2·17	32·34	31·43
Wellington	1·82	11	0·69	3·24	41·02	48·09

South Island.

	Inches.		Inches.	Inches.	Inches.	Inches.
Westport	9·14	21	1·62	6·60	64·81	78·31
Greymouth	6·66	22	1·14	8·95	73·72	104·13
Hokitika	11·48	22	2·10	10·51	93·59	116·53
Arthur's Pass	20·73	16	3·00	12·02	146·29	147·11
Okuru, Westland	13·12	17	3·06	11·73	118·56	148·32
Collingwood	8·49	12	1·79	8·01	88·11	99·81
Nelson	1·19	3	0·65	2·70	40·32	37·60
Spring Creek, Blenheim	0·74	5	0·55	1·93	35·32	30·12
Tophouse	1·66	13	0·81	5·00	55·63	60·78
Hammer Springs	1·47	5	0·15	2·89	50·52	39·11
Highfield, Waiau	1·62	5	0·46	2·51	46·53	33·38
Gore Bay	1·74	8	0·63	2·12	32·83	31·63
Christchurch	2·30	9	0·88	2·03	31·30	25·00
Timaru	1·02	8	0·60	2·38	22·23	23·15
Lambrook, Fairlie	1·75	9	0·93	2·33	21·04	25·09
Benmore, Omarama	2·12	9	0·94	1·77	22·60	24·15
Oamaru	1·23	7	0·83	2·06	19·72	22·03
Queenstown	3·50	8	0·88	2·55	31·54	30·39
Clyde	1·45	5	1·10	1·79	15·13	15·03
Dunedin	1·90	11	0·65	3·49	44·70	36·85
Gore	2·25	16	0·42	3·36	..	34·44
Invercargill	3·10	19	0·44	4·36	47·83	46·48

STUD PIGS FROM ENGLAND.

THE six stud pigs which arrived from England for the Department of Agriculture last month have been placed at the Central Development Farm, Weraeroa, for the present. The pigs are as follows: One Large White boar, Towgood Bar None 12th; two Large White sows, Towgood Diana 3rd and Towgood Lily 7th; one Large Black boar, Gage Orpheus; two Large Black sows, Gage Forest Lass 4th and Gage Forest Echo. All these pigs were bred by Messrs. Edward Towgood and Sons (Limited), of Sawston Mill Farm, Cambridgeshire. The two first-named animals of each breed were presented to the New Zealand Government by Mr. H. G. Spicer, who is a director of Towgood and Sons. The second sow in each case was purchased by the Government. These two were served before leaving England—the Large White by a boar, Bourne Champion Boy 38th, who won first prize at last year's Royal and other leading shows in England; and the Large Black by a very fine boar named Ashby Lex. The other boars and sows of the respective breeds are being mated together here. Full pedigrees of all the animals are held by the Department.

APPLE-PACKING STANDARDS FOR THE LOCAL MARKET.

A SYSTEM of sale for the local markets was devised last year under which fruit may be graded by the grower according to certain standards, and labelled by him accordingly, labels or "stickers" of different colours denoting the various grades. At the auction mart such fruit is set aside and examined by a Fruit Inspector of the Department of Agriculture, who either confirms the grade or, if necessary, alters it in accordance with the true quality. The fruit is then offered for sale—practically under a Government guarantee—buyers being able to purchase confidently as to the quality of the goods. The system was successfully tested in the Wellington market last year, and will be introduced generally in the other local markets of the Dominion should sufficient demand for same be made by growers in the respective districts.

The following standards have been adopted by the Department to apply to the sale of "sticker fruit" (as it is termed) during the ensuing season:—

Extra Fancy Grade (Blue Sticker).—Apples of this grade shall be of not less size than $2\frac{1}{2}$ in. (225 per case), sound, smooth, and clean. They shall be mature, well formed, hand-picked, true to name, and free from disease, spray-injury, visible bitter-pit, skin-puncture, or skin broken at stem, and other defects. Apples slightly affected by unnatural russet, or slightly blemished apples, may be included in this grade, provided that no individual apple shall have more than $2\frac{1}{2}$ per cent. of its surface affected thereby. The individual apples of solid red, partial red, and striped varieties shall carry not less than 75 per cent., 50 per cent., and $33\frac{1}{3}$ per cent. respectively of good typical colour. The individual apples of yellow or green varieties shall be of good characteristic colour.

Fancy Grade (Red Sticker).—Apples of this grade shall be of not less size than $2\frac{1}{2}$ in. (225 per case), sound, smooth, and clean. They shall be mature, well formed, hand-picked, true to name, and free from disease, visible bitter-pit, skin-puncture, or skin broken at stem, and other defects. Slightly blemished apples may be included in this grade, provided that no individual apple shall have more than 5 per cent. of its surface affected thereby. Apples affected by unnatural russet may also be included in this grade, provided that no individual apple shall have more than 5 per cent. of its surface affected thereby. The individual apples of solid red, partial red, and striped varieties shall carry not less than 50 per cent., 25 per cent., and 20 per cent. respectively of good typical colour. The individual apples of yellow or green varieties shall be of good characteristic colour.

Commercial A (Yellow Sticker)—Apples of this grade shall be of not less size than $2\frac{3}{8}$ in. (220 per case), excepting such special dessert varieties as may be approved by the Director of the Horticulture Division, in which case the minimum size shall not be less than $2\frac{1}{2}$ in. (225 per case). They shall be mature, sound, smooth, clean, well formed, hand-picked, true to name, and free from disease, visible bitter-pit, skin-puncture, or skin broken at stem, and other defects. Slightly blemished apples may be included in this grade, provided that no individual apple shall have more than 5 per cent. of its surface affected thereby. Apples affected by unnatural russet may also be included in this grade, provided that no individual apple shall have more than 15 per cent. of its surface affected thereby. The individual apples of solid red, partial red, and striped varieties shall carry not less than 30 per cent., 15 per cent., and 10 per cent. respectively of good typical colour. The individual apples of yellow or green varieties shall be of good characteristic colour.

Commercial B (Yellow Sticker with Diagonal Bar).—Apples of this grade shall be of not less size than $2\frac{3}{8}$ in. (200 per case), excepting such special dessert varieties as may be approved by the Director of the Horticulture Division, in which case the minimum size shall not be less than $2\frac{1}{2}$ in. (225 per case), moderately clean, sound, mature, true to name, free from disease (excepting black-spot) and visible bitter-pit. Blemished apples may be included in this grade, provided that no individual apple shall have more than $7\frac{1}{2}$ per cent. of its surface affected thereby. Apples affected by unnatural russet may also be included in this grade, but no individual apple shall have more than $33\frac{1}{3}$ per cent. of its surface affected thereby. Apples affected with black-spot may be included in this grade, provided the aggregate area of such infection does not exceed $\frac{1}{8}$ in. in diameter with respect to Delicious, or $\frac{3}{8}$ in. with respect to all other varieties.

General.—Five per cent. reduction in the colour requirements of Fancy grade will be allowed as for export. Fifty per cent. of russet will be allowed in Fancy and Commercial A grades with respect to Sturmer apples; there will be no russet restrictions on Sturmers in Commercial B grade; provided that in neither case the apple is distorted thereby.

Stickers may be obtained from the Horticulture Division, Department of Agriculture, Wellington, or from any district Orchard Instructor.

WORLD'S WHEAT SUPPLIES AND REQUIREMENTS.

ACCORDING to an estimate made by the International Institute of Agriculture the wheat-exporting countries are, theoretically, in a position to furnish to the importing countries during the cereal season from 1st August, 1923, to 31st July, 1924, about 570 million centals of wheat. To this quantity Canada could contribute about 221 million centals, the United States a little over 112 million, India 12 million, Argentina 122 million, Australia 55 million, while the Balkans, Hungary, Russia, and the French colonies in North Africa could furnish altogether about 45 million centals.

The Institute states that estimates of probable requirements in the importing countries are not at all easy to prepare for the current season, owing to recurring difficulties presented by the financial and economic conditions existing in sundry European States and by the efforts of some Governments to limit imports of foreign wheat. In pre-war times it might generally be assumed that individual consumption in a given country would not vary much from year to year. Having ascertained the quantity produced in a certain country during a stated season, it was possible to define with fairly close approximation the quantity of wheat required to supplement home production during the twelve months. Now, however, the basis for such an estimate has become much less secure, and it by no means follows that a short crop entails a correspondingly larger import, or *vice versa*. There is proof of this in effecting comparison between data of production and imports for the two seasons 1921-22 and 1922-23 respectively.

Although the 1922 crops in importing countries were 110 million centals less than in 1921, these countries took, between 1st August, 1922, and 31st July, 1923, much the same quantity of foreign wheat. For the most part the causes leading to such a decline in consumption are still in operation. Even if the plentiful yields so general in 1923 should result, for some countries, in a larger consumption than last year's, it seems probable that import requirements between 1st August, 1923, and 31st July, 1924, will be on a more restricted scale than those of last season. In any event these imports are unlikely to exceed last year's total of 430 million centals.

To sum up: (1.) The quantity of wheat that theoretically might be despatched by the exporting countries to the importing States between 1st August, 1923, and 31st July, 1924, is about 570 million centals. (2.) The quantities required for the same period by importing countries to supplement their home production may reach 430 million centals at most, but it is improbable that this figure will be attained. (3.) The quantity available in exporting countries will therefore suffice to meet the requirements of the importing countries until the next harvest in the Northern Hemisphere and to leave a surplus on hand at 1st August, 1924. This surplus may be estimated at not less than 140 million centals.

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 5th January: Peas—General demand for round blue, and small hand-picked Dutch and English have advanced about 40s. per ton. New Zealand ex store are worth £17 to £21 per ton according to quality; Tasmanian about £22. Large quantities of Japanese arriving and afloat quoted at £21 15s. c.i.f. Better inquiry for maple, but stocks of New Zealand are large; ex store quotations are New Zealand, 73s. to 75s. per 504 lb.; Tasmanian, 90s. to 95s.; Tasmanian February shipments quoted at 95s.; February-March shipments, 87s. 6d. Beans—English selling at 42s. to 45s. per quarter.

INVENTIONS OF AGRICULTURAL INTEREST.

With a view to giving as much publicity as possible to inventions, thus promoting industry, the New Zealand Patent Office now supplies copies of full specifications and drawings of inventions for which applications for patents have been received by it, at a charge of 1s. each.

Recent applications for patents of agricultural interest (published with abridged specifications in the *New Zealand Patent Office Journal*) include the following:—

Milk measuring and sampling appliance (J. W. Fuge and W. Barton, Featherston); tractor-plough-height adjustment (W. Bowis, Doyleston); appliance for measuring and sampling milk (K. Prime, Wellsford); milking-machine (J. Edmonds, Mata, Whangarei); bag loader and unloader (D. W. Ross, Kaiapoi); chicken-brooder (H. J. L. Williams, Spreydon, Christchurch); link-attaching rack for swingletrees (Booth, Macdonald, and Co., Christchurch); vacuum-producer for milking-machines (R. Preston, Mangapapa); cheese-press (W. L. Luxford, Auckland); milking-machine pulsator (R. F. Mehrstens, Te Aroha); shearing-comb and fixed cutter (M. W. McArdle, Chicago); releaser and measurer for milking-machines (D. M. Wallace, Te Aroha); milking-machine improvement (N. J. Daysh, Palmerston North); apparatus and process for magnetic separation of seeds (Elizabeth M. Bedell, Limpsfield, England); device for fruit, &c., stacking in storage (D. Blanche, Mapua); milking-machine milk-measuring apparatus (D. M. Wallace, Te Aroha); concrete fencing-post (R. T. Saunders and L. G. Benton, Featherston).

No recommendation of any of the above-mentioned inventions is implied by this notice. Applications for copies of specifications, &c., should be addressed to the Registrar of Patents, Wellington.

FORTHCOMING AGRICULTURAL SHOWS.

Woodville A. and P. Association: Woodville, 22nd and 23rd January.
 Horowhenua A. and P. Association: Levin, 30th and 31st January.
 Feilding I., A., and P. Association: Feilding, 5th and 6th February.
 Buller A. and P. Association: Westport, 8th and 9th February.
 Clevedon A. and P. Association: Clevedon, 9th February.
 Rodney Agricultural Society: Warkworth, 9th February.
 Dannevirke A. and P. Association: Dannevirke, 13th and 14th February.
 Te Puke Agricultural Association: Te Puke, 14th February.
 Masterton A. and P. Association: Solway, 19th and 20th February.
 West Coast A., P., and I. Association: Greymouth, 19th and 20th February.
 Whakatane A. and P. Association: Whakatane, 20th February.
 Katikati A. and P. Society: Katikati, 21st February.
 Franklin A. and P. Society: Pukekohe, 22nd and 23rd February.
 Rotorua A. and P. Association: Rotorua, 27th February.
 Opotiki A. and P. Association: Opotiki, 27th February.
 Tauranga A. and P. Association: Tauranga, 28th February.
 Waipu Agricultural Association: Waipu, 28th February.
 Omaha and Pakiri A. and H. Society: Leigh, 1st March.
 Taumarunui A. and P. Association: Taumarunui, 5th March.
 Taranaki Metropolitan Agricultural Society: New Plymouth, 5th and 6th March.
 Waikato Central Agricultural Association: Cambridge, 5th and 6th March.
 Mangonui County A. and P. Association: Kaitia, 8th March.
 Morrinsville A., P., and H. Society: Morrinsville, 12th March.
 King Country Central A. and P. Association: Te Kuiti, 13th March.
 Hawke's Bay A. and P. Society: Hastings, 18th and 19th March.
 Mayfield A. and P. Association: Mayfield, 22nd March.
 Methven A. and P. Association: Methven, 27th March.
 Temuka and Geraldine A. and P. Association: Winchester, 3rd April.

(*Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.*)



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THE GRASSLANDS OF NEW ZEALAND.

(Continued.)

THE AGROSTIS SPECIES—RED-TOP, BROWN-TOP, AND CREEPING-BENT.

E. BRUCE LEVY, Biological Laboratory, Wellington.

THERE are few grasses of economic importance more puzzling in form and character than those belonging to the genus *Agrostis*, and there are none perhaps over which a greater confusion exists at the present time in the mind of the farmer, the seed-merchant, the green-keeper, and even the specialized botanist. The names red-top, brown-top, Waipu brown-top, fiorin, twitch, creeping bent, carpet-bent, velvet-bent, *Agrostis alba*, *A. vulgaris*, *A. capillaris*, *A. canina*, *A. stolonifera*, *A. palustris*, and *A. tenuis* have been variously applied and much confused. The present article has been prepared to clear up this confusion, and it also aims to deal fairly comprehensively with the ecology and agricultural status of the *Agrostis* species as they occur in New Zealand.

There are three distinct and fairly easily recognizable agricultural species common in New Zealand, and in the naming of these the writer is keeping in accord with Piper,* *Agrostologist*, United States

* U.S. Department of Agriculture Bulletin No. 692, *The Agricultural Species of Bent Grasses*; and personal correspondence.

Department of Agriculture. These three species are: (1) Red-top (*Agrostis palustris*), (2) brown-top, or colonial bent (*Agrostis tenuis*), and (3) creeping-bent (*Agrostis stolonifera*).

Other common and botanical names that have at times been applied to these species are—

(1.) Red-top (*A. palustris*): *A. alba* of most botanists; fiorin of the seed trade; *A. stolonifera* of some merchants' catalogues; twitch.

(2.) Brown-top, or colonial bent (*A. tenuis*): *A. vulgaris* of most botanists; *A. capillaris* (of some American botanists); Waipu brown-top (of Auckland seed-growers and seed-merchants); twitch, or red-top (of Canterbury Plains and South Island generally); *A. canina** (of some merchants' catalogues); Rhode Island bent (of America).

(3.) Creeping-bent (*A. stolonifera*): Carpet-bent (of American green-keepers); fiorin (of Dr. William Richardson, of Moy, Ireland); *A. depressa* and *A. maritima* (of some American botanists).

The species as above defined are by no means single entities. At best all are big aggregates, each containing many puzzling forms. The aggregate species, however, are sufficiently clean-cut to be recognized in the field, and each is confined more or less to a definite habitat. The cause of variation within and between the species is extremely difficult to account for, but it would appear that hybridization played an important part, for it is in areas where the three species may be found together that one notes the greatest variation and often the most puzzling of forms. Again, where the habitat is such as to favour only the one species the growth-form and character of that species becomes more constant. Also, there is affinity between the aggregate species. This affinity asserts itself not so much by a general similarity in the plants, but rather by a manifestation of special features such as the appearance of the long rhizomes in otherwise short rootstock forms, or by the ready stolon development of otherwise non-stolon erect forms. These variations are distinct from habitat variations, which at times are extremely marked—so much so that to define the vegetative growth-form of the species botanically is almost impossible.

From an agricultural point of view the three species mentioned above are economically and ecologically separate and distinct. One is justified, therefore, from such point of view in accepting these three species, and it is hoped that the following descriptions and accompanying illustrations will serve to enable farmers and others to distinguish between them. In the main only macroscopic characters are illustrated—such as may be seen with the naked eye or with a lens magnifying up to ten diameters.

RED-TOP (*AGROSTIS PALUSTRIS*).

General Description.

This is the strongest-growing grass of the three. In habit it is usually erect and somewhat stiff (Fig. 1). The leaves are broad,

* *Agrostis canina* (velvet-bent) is a fairly distinct species resembling in general growth-form creeping-bent (*A. stolonifera*). The plant is not found growing in New Zealand under field conditions.

(All photos by E. Bruce Levy.)

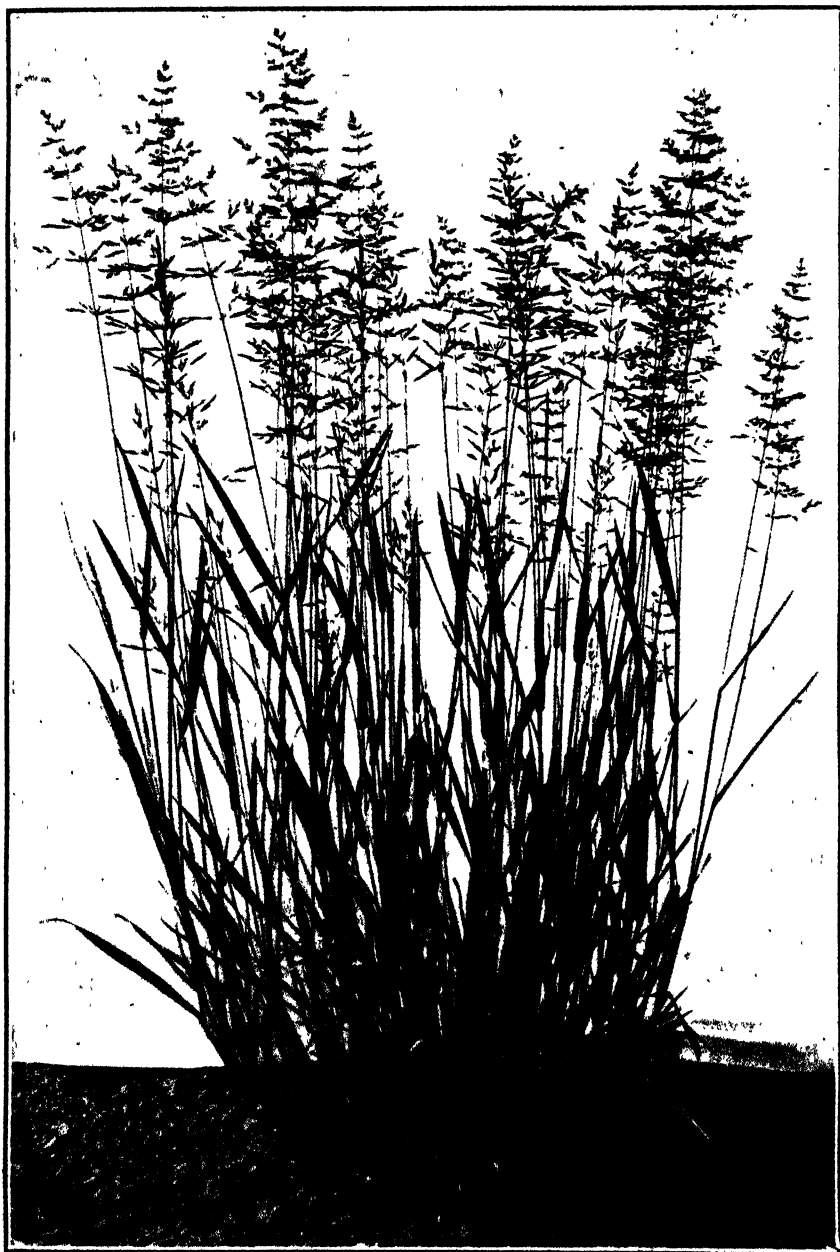


FIG. 1. RED-TOP (*AGROSTIS PALUSTRIS*).

$\frac{3}{8}$ in. wide in well-grown specimens, erect when young, drooping when older. The ligule* is large, up to $\frac{1}{4}$ in. long, broad at the apex and often somewhat frayed, particularly on the older leaves (Fig. 2). The ligule of the uppermost leaf on the shoot is very conspicuous, encircling completely the succeeding young leaf while this is still rolled in the bud. The rootstock is stout, and long rhizomes (underground stems) are characteristic (Fig. 3). The rhizomes are many-noded, each node bearing roots, and a bud which may or may not develop. It is on account of these rhizomes that the name "twitch" has been applied to this grass by farmers on arable land. The tillering buds are stout and below ground. The lower ones on the base of the vegetative shoot (crown) usually develop into rhizomes, while the upper ones may form new vegetative aerial shoots. The buds are generally few in number, so that compact many-tillered shoots are rarely found in this species.

The rhizomes push slanting-wise downwards from the crown and extend along at a depth of some 1 in. to 3 in. in the soil, occasionally giving off shoots from buds along the rhizome. More usually, however, the vegetative shoots are borne at the end of the rhizome, which turns up and projects through the ground maybe some 12 in. away from the parent plant. From these terminal aerial shoots numerous roots are given off, which become the functional roots for the upward and seasonal growth of the aerial shoots. The crown of these shoots remains below ground. At first only a single shoot appears, which may or may not be supplemented later by other shoots. It is rather characteristic of red-top that the shoots appear at fairly widely spaced intervals, and that each crown bears only a few aerial shoots. Thus one seldom finds this species forming a dense close turf, but one that is usually very coarse and open. To green-keepers, bowlers, &c., it will be obvious, therefore, why red-top is undesirable as a lawn-grass.

The flower-head (panicle) is fairly characteristic—large, somewhat coarse, with the branchlets arranged in definite whorls. The primary branchlets are usually straight to the tip, and the two secondary branchlets coming off this about half-way along form a very narrow angle with it (Fig. 4). Before and after flowering the whorled appearance is very obvious, but during the flowering-period the branchlets are more widely disposed, expanding before and then compacting again after fertilization. The flowering-culm is tall, up to 30 in. high, and is usually erect, but dense growth may lodge somewhat. The aerial shoots scarcely ever give off branch shoots above ground.

Ecology and Agricultural Status.

Red-top grows best in loose, damp, rather rich soils, but it will thrive and persist for many years on poorer, drier soils, particularly if such soils are periodically worked up with the plough. The growth-form of the plant almost demands a rather loose soil, for such soils give easy penetration to the rhizome, which is the only means

* The ligule is the white membranous structure at the base of the leaf, and is of great value in grass-identification.

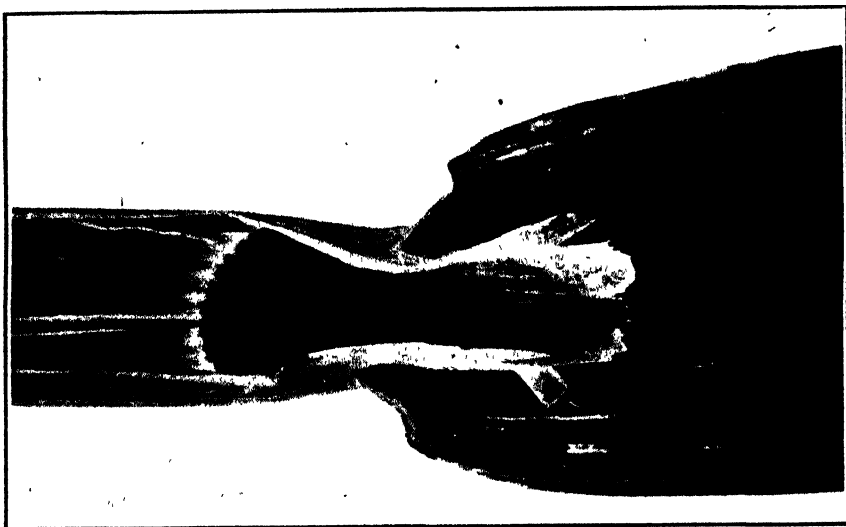


FIG. 2. BASE OF LEAF OF RED-TOP, SHOWING LIGULE. MAGNIFIED 10 DIAMETERS.
The stem has been cut away just below the leaf-base.

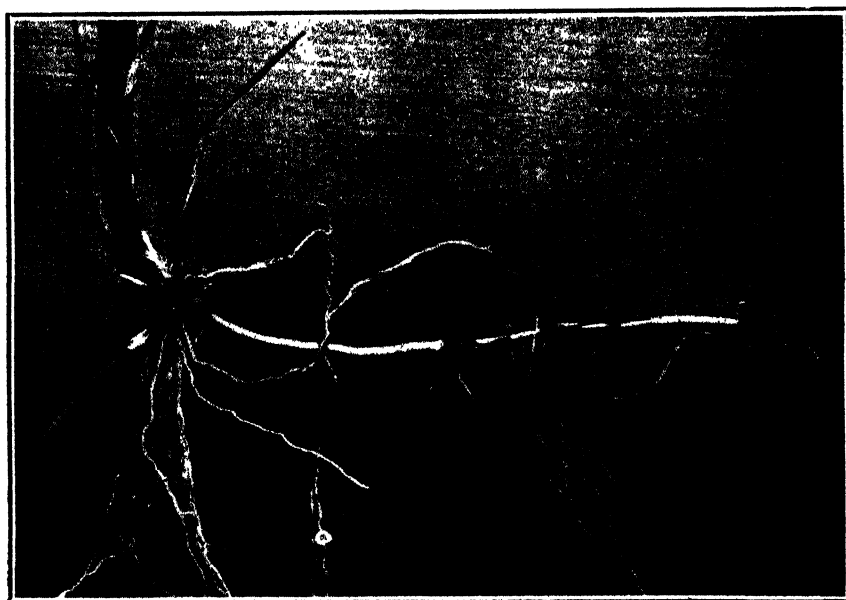


FIG. 3. UNDERGROUND STEM (RHIZOME) OF RED-TOP.

Note the stout rhizome and the few vegetative aerial shoots terminating it.
A young rhizome may be seen rising from the crown.

of vegetative spread that this grass has. So long, then, as the ground containing red-top is kept loose by working or by the peaty or loose nature of the soil it will persist for years, but so soon as consolidation is effected the growth becomes more stunted and the shoots become more sparse and slender; and if it is competing with a grass more at home on this consolidated soil the red-top almost invariably will be ousted from that soil. In New Zealand

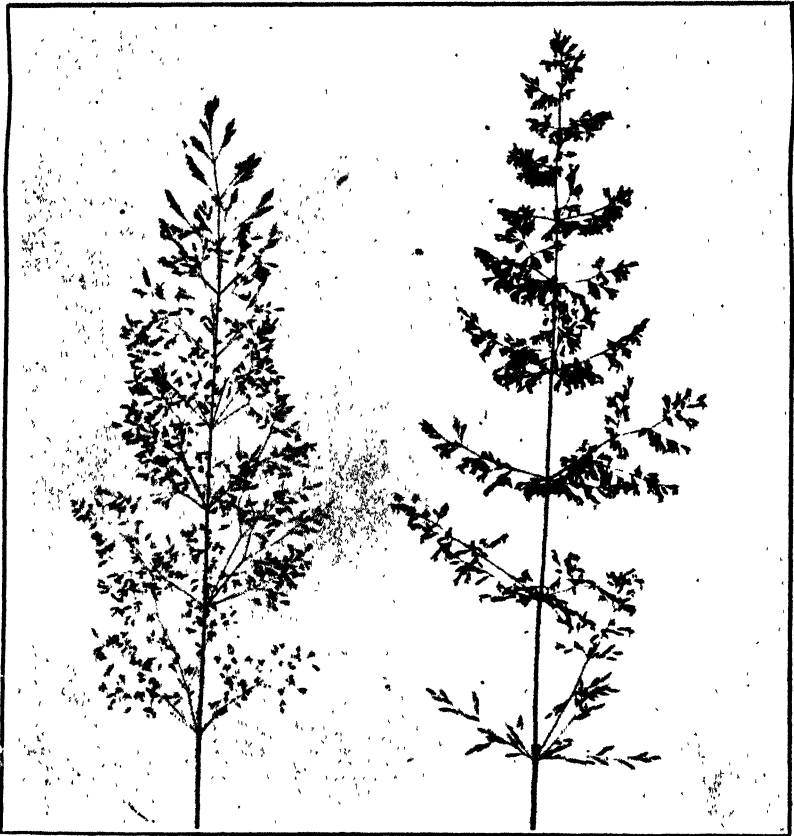


FIG. 4. FLOWER-HEAD (PANICLE) OF RED-TOP (ON RIGHT) AND BROWN-TOP (ON LEFT), BOTH IN FULL FLOWER.

Note the straight branchlets of red-top and the angled ones of brown-top.

many tons of red-top seed have been sown over a wide range of soils, but the grass to-day nowhere predominates in any old-established pastures. In waste places, particularly throughout peat-swamp lands, it may be frequently seen; and on arable land it at times proves very persistent, being there one of the worst twitch weeds. In these cases the loose nature of the soil is largely responsible for its persistence.

On the hill country in Taranaki red-top, sown years ago is still persisting, but the plants are poor and spindly and productive of very little feed. Its persistence at all there is due to the rather loose nature of the soil, the rather heavy rainfall, and the lack of competition of close turf-forming grasses. On the poorer, heavier, and more consolidated soil red-top will not persist in the permanent pasture. On these soils brown-top or danthonia are almost certain to replace the red-top. A good example of this recently came under the writer's notice. Specimens from three fields near Masterton were received at the Laboratory for determination of species. Of these fields one was sown down twelve years ago with florin from Germany, and the other two were sown twenty-five years ago with red-top. All the specimens sent in were brown-top. Brown-top is a truly successional species on nearly all the good second-class soils of the Wairarapa, and red-top even if sown there would apparently go out in the course of time before the brown-top advance. This also will be very largely true of the heavier soils in New Zealand generally—those of Southland, the gum-lands of North Auckland, the heavy clays of the Marton district, and those of the Wairarapa may be mentioned; but if these lands are worked and not allowed to consolidate, then the red-top will persist.

Agriculturally red-top is of no significance in New Zealand, and in the writer's opinion not a pound of seed of this grass should be imported into the country. It may have a place on certain wet, peat-swamp lands, but, generally speaking, better grasses may be successfully introduced there. The seed is frequently used as a component of lawn-mixtures, but as a lawn-grass it ranks as one of the poorest. It may act as a quick cover for the first year or so, but perennial rye-grass would be much better for this purpose. Many grievous errors have been made by seed-merchants in contending that agriculturally red-top or florin is to all intents and purposes the same as brown-top, and the former has been often supplied instead of brown-top for hill-country sowings and for lawns. A greater mistake than this could not be made; red-top is practically useless on hill country or on lawns, whereas brown-top is one of the best grasses. The seeds of these two species certainly are alike, but the habits and growth-form of the plants are essentially different.

BROWN-TOP OR COLONIAL BENT (*AGROSTIS TENUIS*).

General Description.

Brown-top (Fig. 5) is a finer grass than red-top. In habit it is usually erect, but trailing shoots and slanting divergent shoots are quite a common feature, particularly in plants that have room to spread. In close-turf forms the shoots are mostly erect, and the closer the turf the finer the foliage. The leaves vary from extremely fine blades up to $\frac{1}{2}$ in. wide; they are erect when young, but come later to occupy a position almost at right angles to the culm. The ligule is short (Fig. 6), scarcely ever exceeding $\frac{1}{16}$ in. long, and in the uppermost leaf hardly noticeably enfolding the succeeding young leaf while rolled up in the bud. Until one knows the plant by eye this short ligule is the best ready means of distinction in the vegetative

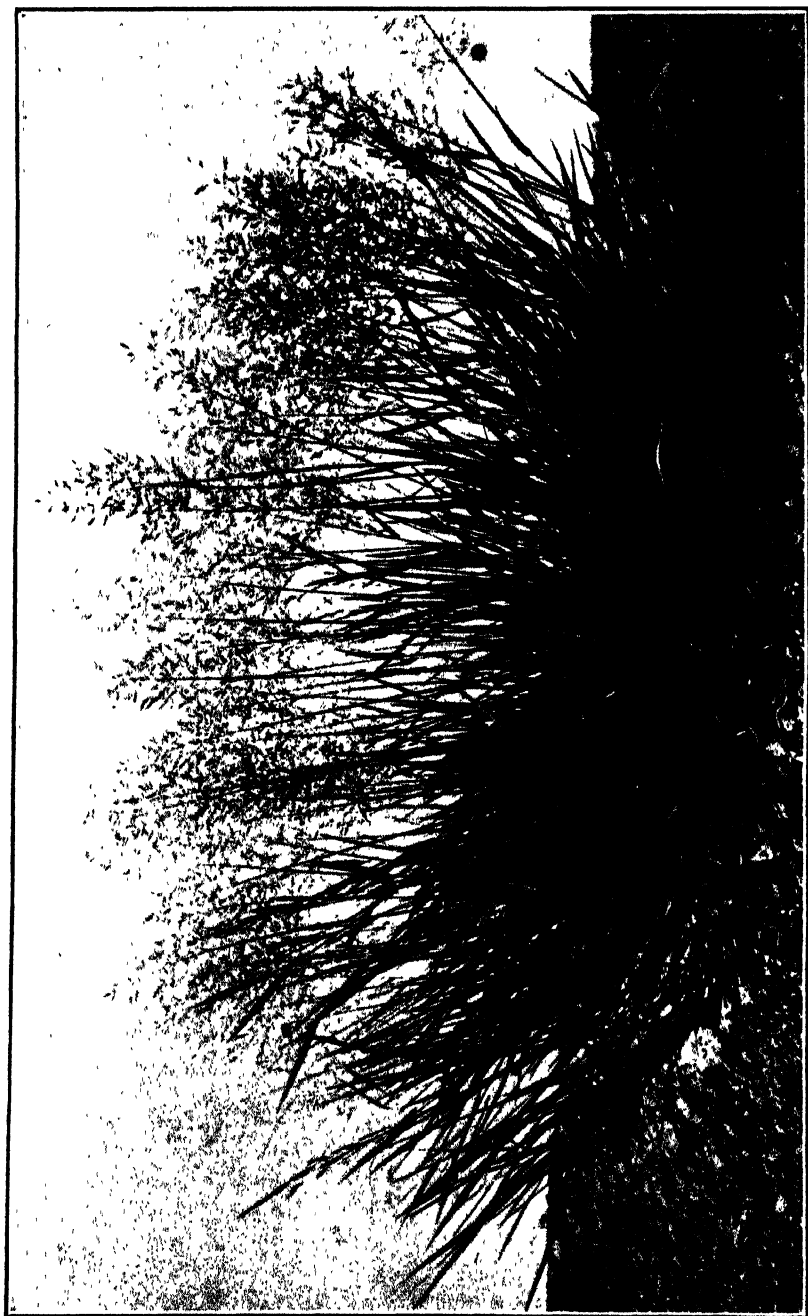


FIG. 5. BROWN-TOP OR COLONIAL BENT (*AGROSTIS TENUIS*).

stage. The rootstock is more slender than in red-top, and long rhizomes are not characteristic when the grass is in the turf form (Fig. 7); but while the grass has room to spread, as in a newly worked field, then rhizomes up to 8 in. long may be formed. On account of these rhizomes, as in the case of red-top, the name "twitch" has been applied to this grass by farmers of arable land, particularly in the South Island. As the ground becomes more consolidated so the length of the rhizome becomes shorter, until in a close turf they become merely short underground stems diverging somewhat from the last year's crown. The tillering buds are borne on these short stems below the ground. When growth commences in the turf condition these buds develop into aerial shoots, almost erect from the crown, with the result that a close turf is formed, and the closer and more numerous these shoots the finer does the turf become.

The rhizomes when formed are somewhat slender compared with those of red-top. They are many-noded, each node bearing roots and a bud, which bud may or may not develop. When these rhizomes are short, adopting really more or less the form of a widely divergent underground tiller, it is usual for all the buds to develop into aerial shoots. On the other hand, if the soil conditions are loose certain of the buds develop into rhizomes. This rather emphasizes the close relationship of the aerial shoot to the rhizome, and the latter would appear to be a one-time aerial shoot that took to the earth to assist the plant in its colonization of light, free, and open soils, or possibly to avoid extinction during periods of drought. In the development of the rhizome red-top would seem to have advanced beyond brown-top as regards this modification, so much so that if conditions are now made such that red-top cannot form these rhizomes the plant rapidly declines and goes out. Brown-top, on the other hand, thrives as well without the rhizome as it does with it, just so long as the fertility of the soil is maintained. Again, in brown-top a very noticeable feature under somewhat shady conditions is the development of aerial shoots bearing lateral shoots. Such shoots undoubtedly will be the homologue of the rhizome.

In brown-top, also, there are frequently found trailing overground shoots which readily root at the nodes whenever these contact the soil, and from such rooting nodes there readily develops an aerial shoot. This character shows somewhat clearly an affinity of brown-top to the third species, creeping-bent. In growth-form, therefore, brown-top is essentially intermediate between red-top, on the one hand, and creeping-bent on the other. As in the case of red-top, each rhizome or underground tiller forms shoots above ground singly at first, but this shoot is soon augmented in brown-top by numerous other shoots rising from the shoot-base (the crown) well below the soil-surface. Thus is formed a dense little tuft of many shoots. These each tiller further the next season, and there soon comes to be formed a dense turf of fine foliage. This dense turf-forming attribute has made brown-top one of the foremost grasses for all manner of playing-greens. To this attribute also is due its success as a bare-ground coverer and sward-former on agricultural (including pastoral) land, placing it as one of the best second-class grasses we have for steep hill country.



FIG. 6. BASE OF LEAF OF BROWN-TOP, SHOWING LIGULE MAGNIFIED 10 DIAMETERS
The stem has been cut away just below the leaf-base.



FIG. 7. UNDERGROUND-STEM SYSTEM OF BROWN-TOP.

Note the numerous vegetative aerial shoots terminating the more slender rhizome (cut short). A subsequent short rhizome has sprung from the crown.

The flower-head (panicle) is characteristic, fairly large, outspreading and fine (Fig. 8). The branchlets are arranged in whorls, but are so disposed that to all intents and purposes the whorled arrangement does not appear as such. The main-branchlet axis is not usually straight to the tip, but is divergent at an angle equal to that made by the secondary branchlets coming off it (Fig. 4). It is this more widely divergent arrangement of the secondary branchlets of the panicle that destroys the whorled appearance. After flowering the

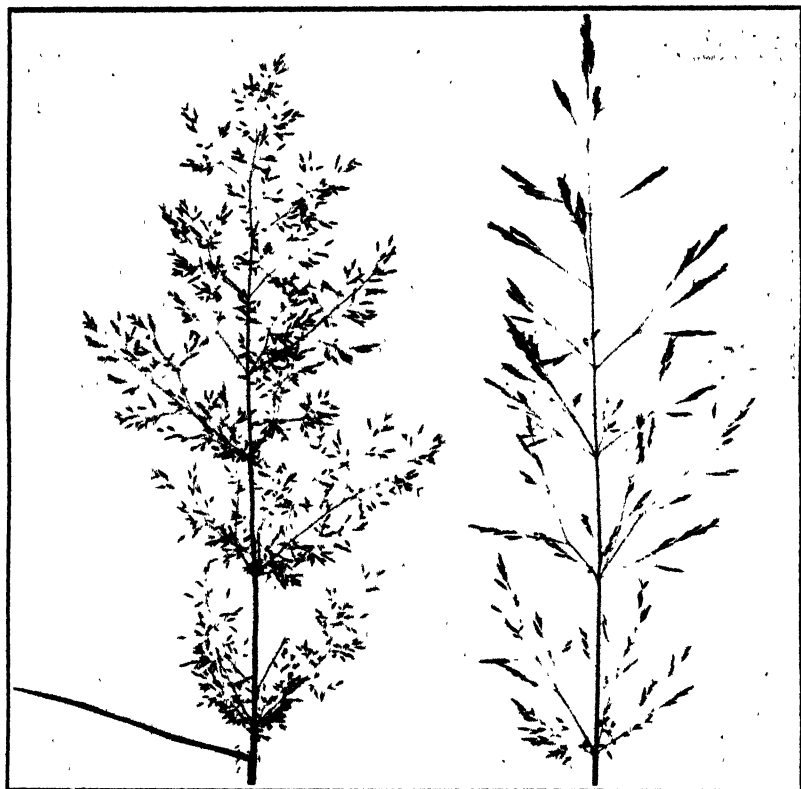


FIG. 8. FLOWER-HEADS OF BROWN-TOP.

That on the left is in full bloom; that on the right is closed somewhat after fertilization has taken place.

panicle may remain fine and open, particularly in warm sheltered spots, but usually the panicle closes up somewhat, especially if the weather is dry and windy at time of flowering (Fig. 8).

The flowering-culm is fairly tall, but not so tall as in red-top (Fig. 9). The flowering-culms are numerous, and present a fine glossy shivery mass of bloom somewhat reddish-purple in colour. After flowering, however, the colour turns to a dull straw colour, and the whole stiffens somewhat in appearance.

Ecology and Agricultural Status.

Brown-top is by far the most common *Agrostis* species in New Zealand, and, agriculturally, it is the most important. Right throughout the country on all the rather heavy, better second-class soils brown-top is a truly natural successional species—succeeding to the better-class grasses and clovers (rye-grass, red clover, &c.) as these go out. The writer looks upon the fact of brown-top growing well as an indication of average first-class short-rotational grassland soils. It marks soil on which perennial rye-grass will persist for about three years. Stiff heavy soils are the most suitable for brown-top, and the grass demands a good deal of moisture—in fact, the moisture factor is

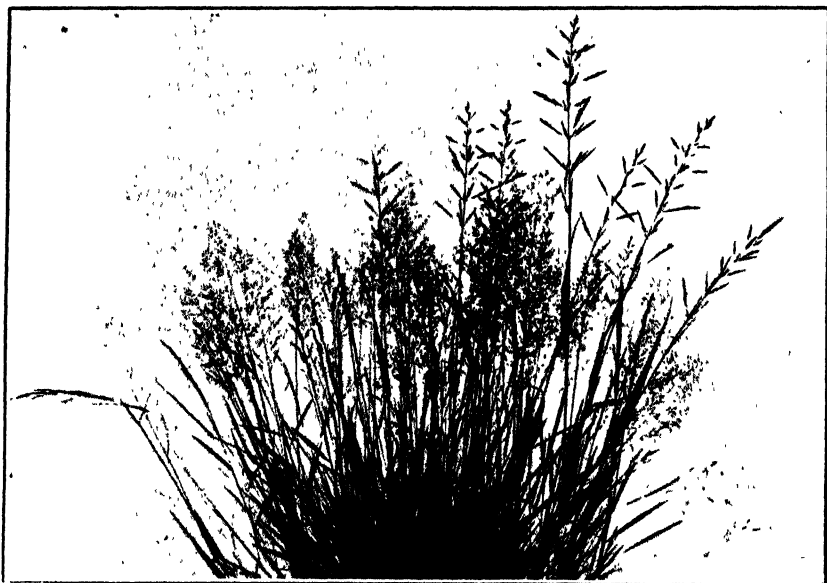


FIG. 9. TURF OF BROWN-TOP AND RED-TOP GROWN FROM A MIXED LINE OF SEED.

The tall coarse heads are those of red-top, the short finer shivery ones those of brown-top.

more important than is the nature of the soil. Brown-top will persist on fairly light dry soils, but on the latter it is very inclined to dry out in the summer or to get sod-bound, so that the yield becomes very low.

The districts most suitable and where brown-top is most prevalent at the present time are the North Auckland better-class gum-lands, the heavy soils of the Wairarapa, Manawatu, Westland, Southland, and north Otago, together with a belt running along the foothills of the Alps in Canterbury. The grass extends in altitude from sea-level up to 3,000 ft., being found in the Mount Cook region and on the volcanic plateau of the North Island. Higher-altitude forms, however, differ slightly from the lowland forms.

On ploughable country, excepting on the poorer second-class soils, brown-top is not looked upon with favour by the farmer as a good grazing proposition, and there is no doubt that it is inferior to the cocksfoot and crested-dogtail sward which it is possible to maintain on these soils when ploughable. Brown-top growing well is a sure indication that the soil there is perfectly adapted for the cocksfoot, crested dogtail, and white clover type of pasture. It has been stated above that the fact of brown-top thriving indicates soil on which perennial rye-grass will last about three years— that is, under ordinary existing management of pastures. In the Department's Bulletin No. 107* it is pointed out that there are four methods of grassing short-rotational grassland soils, one being by the transitional system (pp. 52–56). If certain species were included in the rye-grass pasture sowings under this system those pastures could remain more than three years and yet not run to weeds. The establishment of a very extensive market for brown-top seed in America, together with the fact that the grass itself is a good second-rate one, should make this system of grassing our better second-class soils more and more remunerative.

On third-class soils brown-top may be used to occupy the land tentatively—that is, until it is gradually replaced by certain other slowly establishing but more permanent species. *Danthonia* or *paspalum*, for instance, are extremely slow of establishment on poor country, and take a long time to form a close sward. Brown-top if included in the mixture will hold such soils after the rye-grass, cocksfoot, &c., have run out and until the *danthonia* or the *paspalum* replace them.

As already mentioned, brown-top, like all turf-forming grasses, is inclined to become sod-bound, and the poorer and drier the soil the more quickly does this come about.†

For hill-country pastures where the rainfall is fairly high brown-top ranks as one of the most important grasses. Owing to its fine seed it establishes readily, and with its penetrating underground-stem systems it ramifies through pukahu and tree-fern stumps, &c., occupying those spots in the bush-burn where ordinarily it is extremely difficult to get other grasses to take; and such spots, it must be remembered, are usually the places for the establishment of the fern-growth which proves so troublesome in the hill-country pastures. Brown-top on hill country really should occupy that grade of soil between the cocksfoot, crested dogtail, and white clover soil-type and the *danthonia* soil-type. All the Taranaki back-country, and the hill lands of the King-country, of North Auckland, of Westland, of Southland, and practically all moderately moist hill country in New Zealand, should have brown-top sown in addition to *danthonia*, and the better grasses—cocksfoot, crested dogtail, *Poa pratensis*, &c.

* *The Grasslands of New Zealand, Series I, Principles of Pasture-establishment*, by E. Bruce Levy. In future articles reference will often be made to this publication (a consolidation of articles which have appeared in the *Journal*), and readers interested in these grassland articles should secure a copy from the Department of Agriculture, Wellington (price 1s.).

† In a future series of articles on pasture-management the writer will deal with the problem of renovation of sod-bound pastures.

Brown-top is now becoming recognized as the most suitable of grasses for all manner of turfed playing-grounds, and practically all the brown-top seed sent out of New Zealand to America is used there in the formation of these greens. Up to the last few years it has been held that brown-top was confined to the North Auckland district, where the seed was harvested and sold under the name of Waipu brown-top. During the last three years the writer has made a very intensive study of the *Agrostis* species in New Zealand, and specimens have been collected * from all over New Zealand and grown at the Biological Laboratory alongside plants raised from type seed from America. It can now be said with certainty that brown-top is the common form of *Agrostis* in New Zealand, and that the form growing in the South Island and other parts is identical with that growing in North Auckland. For lawns and playing-greens there is no doubt that brown-top is the grass *par excellence*, producing as it does a very fine and even turf, and being sufficiently hardy to stand the severe conditions of wear and close cutting that many greens are subject to.

It has been stated before that red-top is extremely poor as a lawn-grass, and in sowing down lawns care should always be taken to ensure that the brown-top seed used is free of red-top. On heavy clays this is not so important, but on loose soils the red-top will persist and cause trouble by its rather stiffly erect shoots. Brown-top seed for export purposes should be entirely free of red-top.

CREEPING-BENT (*AGROSTIS STOLONIFERA*).

General Description.

The characteristic feature of this grass is its long trailing overground stems (stolons) (Fig. 10), which root at the nodes whenever these come into contact with the slightest moisture (Fig. 11). From the rooted nodes an aerial erect shoot is given off. At the base of this shoot tillers may be formed, the lower ones at least of which will develop into the trailing overground stems. Under close turf conditions the tendency to form long trailers is somewhat reduced, and then numerous rather fine erect shoots are formed, which under close grazing or close mowing form a dense turf. Just so soon, however, as the turf is allowed to get away the stolon habit reasserts itself, and there may be formed a dense mat of intertwined stolons each sending up shoots at the nodes and forming a regular carpet. The American agrostologists have, in fact, in one publication called this grass the "carpet-grass." The rootstock and crown are entirely above ground, and there is no formation whatsoever of underground rhizomes.

The leaf is a trifle paler green in colour than that of brown-top, somewhat shorter and stout, tapering gradually from the base to the apex. On the older portion of the shoot the leaves are lax and somewhat drooping; towards the tip of the shoot they are stiffer and usually closely appressed towards the stem, thus forming with the latter a very narrow angle. The ligule is long and somewhat pointed, usually exceeding that of red-top in length, but being much narrower

* In the collecting of these *Agrostis* species the writer is indebted to several officers of the Fields Instruction Service for their assistance.



FIG. 10. CREEPING-BENT (*AGROSTIS STOLONIFERA*).
Young plant showing characteristic overground trailing stem (stolon).

and less frayed at the tip (Fig. 12). The ligule of the uppermost leaf is readily discernible, enfolding the young succeeding leaf while this is rolled up in the bud. This long white membranous ligule readily distinguishes creeping-bent from brown-top, and the growth-form resembles in no way that of red-top. The flowering-culm is scarcely ever strictly erect, being curved and kneed at the nodes. The panicle (Fig. 13) is usually short and smaller than that of red-top or brown-top; it is somewhat open when in flower, but readily compacting to a close almost spike-like form, the branchlets being compressed close in to the main axis or rachis of the panicle.



FIG. 11. ROOT-SYSTEM OF CREEPING-BENT.

The creeping overground stem roots freely at the nodes wherever moisture is present.

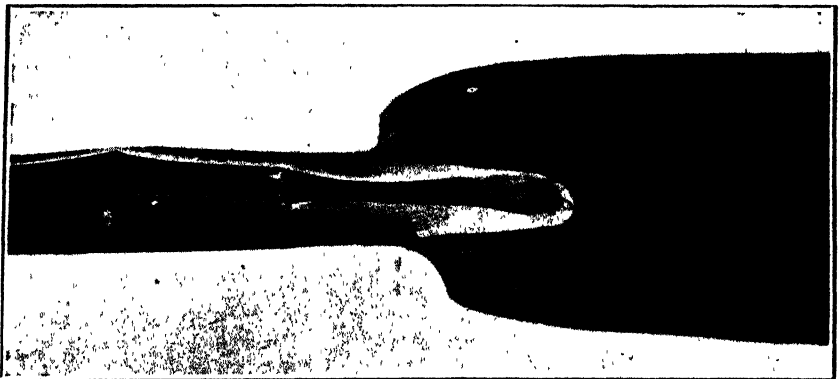


FIG. 12. BASE OF LEAF OF CREEPING-BENT, SHOWING LIGULE. MAGNIFIED 10 DIAMETERS.

The stem has been cut away just below the leaf-base.

Ecology and Agricultural Status.

Creeping-bent is widely distributed throughout New Zealand, but agriculturally it is of minor importance only. Its habitat is very confined, the ideal situation for its greatest growth being in wet somewhat waterlogged soils. It is commonly found on hillsides bordering springs; in fact, wherever the soil is moist at the surface for the greater portion of the year there will creeping-bent be found, providing that the vegetation in those spots is somewhat sparse and open.

Creeping-bent will not compete successfully with other grasses that are stronger-growing and which form a fairly dense cover. On the

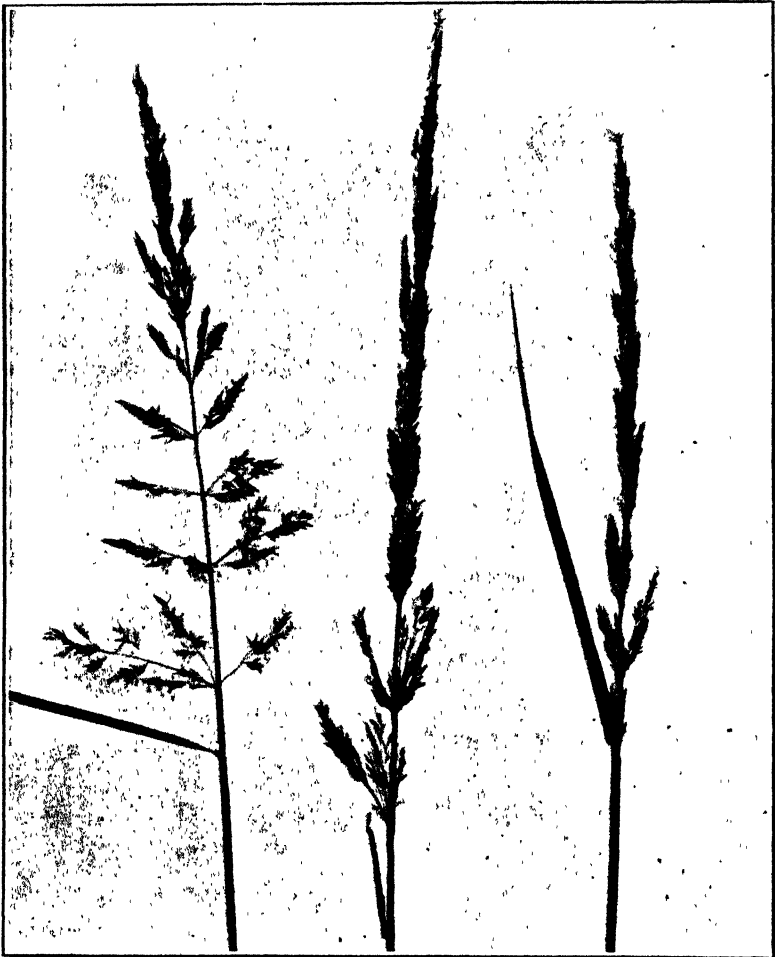


FIG. 13. FLOWER-HEADS OF CREEPING-BENT.

That on the left is in full flower; those on the right show the typically compacted panicle after flowering.

richer portions of the Hauraki Plains, for example, it is the common grass on the roadsides, but through the fences inside the paddocks, where the rye-grass and meadow-foxtail type of pasture prevails, creeping-bent does not enter in to the pasture sward. The grass will stand inundation of flood-waters for weeks at a time, and it grows freely in water up to 6 in. deep, but deeper submersion than this for any length of time will kill it. The grass associates at times with brown-top where this grass is thinned out somewhat through being in situations a little too wet for its growth. Creeping-bent is also at times to be found in closely grazed damp pastures.

The herbage produced by creeping-bent is small in quantity and is not particularly palatable to stock. In Ireland Richardson commercialized this grass under the name of "florin." Seed could not be obtained, but the grass was vegetatively distributed, the long trailing stolons being cut into short lengths. Each length containing a node will readily form a new plant when strewn on damp soil. Richardson claimed a great yield from this grass on the bog-lands of Ireland, but in New Zealand the yield is never high, and, generally speaking, the soils that would produce big crops of creeping-bent here are utilized for the production of more palatable grasses such as meadow-foxtail, *Poa trivialis*, timothy, &c.

The seed of creeping-bent has never been placed on the market, but German mixed bent, which is mainly brown-top, regularly contains about 1 per cent. of creeping-bent. Its presence in commercial lines enhances the value of German brown-top seed in the estimation of American green-keepers. The name "florin" has come to be associated with imported red-top by the seed trade. Formerly it was applied to seed from Germany, but now is more generally used for all imported red-top seed.

As a playing-green grass creeping-bent is very popular at the present time in America, where putting-greens, &c., are laid down with it, the vegetative method of propagation being adopted. Under liberal top-dressings of soil and with a plentiful supply of water creeping-bent can be made to produce a very fine and even turf. Without this attention, however, it is of no use as a fine playing-green grass. If the runners are allowed to form above ground a matted, uneven, and spongy turf is formed, which also readily dries out with hot weather. The effect of soil top-dressing is to cover up any trailing stems, and so keep the crown below the surface. If this soil top-dressing is not regularly done the grass becomes objectionable. As a general-purpose playing-green grass creeping-bent does not compare at all favourably with brown-top.

CONCLUSION.

The foregoing is a general classification of the *Agrostis* species in New Zealand. Each species is more or less an aggregate, in itself ecologically and economically distinct from the other two. There are many intermediate floristic forms, but to separate these would, the writer feels, further confuse the *Agrostis* position in New Zealand rather

than elucidate it. If in the future course of these grassland studies one form is met with that shows qualities above another, then it will be time enough to subdivide any one of the three existing well-defined aggregate species here dealt with.

(Series to be continued.)

GERMINATION OF AGRICULTURAL SEEDS.

NEW ZEALAND OFFICIAL TESTS, 1923.

THE following table shows the average germinations of agricultural seeds tested at the Department's seed-testing station during the calendar year 1923. The figures are compiled from the analyses of approximately 10,000 commercial samples in that period.

Seed	Average Germina- tion	Seed	Average Germina- tion
<i>Principal Seeds</i>			
	Per Cent.		Per Cent.
White clover	90.8	Prairie-grass	64.2
Alsike	90.3	Crested dogtail	90.3
Cow grass	92.5	Cocksfoot*	70.0
Crimson clover	88.1	Paspalum	29.5
Lucerne	91.8	Oats	84.9
English trefoil	74.1	Peas	92.9
Lotus major	80.3	Turnip	87.8
Lotus angustissimus	53.0	Swede	85.3
Perennial rye-grass	81.1	Rape	91.2
Italian rye-grass	85.0	Kale	88.4
Western Wolths rye-grass	84.4	Mangold	147.3
Timothy	93.7	Mustard	86.1
Brown-top	80.0	Carrot	69.5
Red-top	86.2	Perennial rye-grass by dis-	
Fiorin	89.0	tricts—	
Chewings fescue	87.7	Southern	78.8
Meadow-fescue	71.5	Canterbury	84.2
Meadow-foxtail	31.4	Sandon	78.3
Danthonia	38.7	Poverty Bay	92.5
Poa pratensis	55.3	Hawke's Bay	93.7
<i>Less Common Seeds.</i>			
Suckling-clover	68.6	Chou moellier	88.0
Subterranean clover	62.6	Maize	89.8
Strawberry-clover	80.6	Tares	94.5
Japanese millet	91.1	Vetch	99.0
Poa trivialis	21.0	Lotus hispidus	77.0
Sorghum	60.3	Black-skinless barley	80.6
Yarrow	84.7	Cape barley	76.5
Yorkshire fog	80.4	Rye-corn	88.0
Indian doob	84.0		

* Akaroa, 68.2; Plains, 79.8; Danish, 72.8 per cent.

—Nelson R. Foy, Biological Laboratory, Wellington.

CIDER-MAKING.

PRACTICE FOR NEW ZEALAND CONDITIONS.

J. C. WOODFIN, Vine and Wine Instructor, Horticulture Division.

WITH the increasing production of apples in the Dominion, and the high standard required in grading both for export and the home market, it is becoming more and more necessary to make profitable use of both the surplus apples in years of superabundance and of those apples which, though otherwise good and sound, are debarred from the higher grades by slight blemishes.

Owing to the facility with which large quantities of fruit can be converted into a most palatable and wholesome beverage, which will keep for years when well prepared, and of which the overproduction in years of plenty can be utilized to level up the stocks in years when the crops are below the average, the manufacture of cider may be looked upon as a most important safety-valve for the New Zealand apple industry.

Much of the cider manufactured in this country has hitherto been prepared by "rule of thumb" or more or less haphazard methods, which if carried out on a commercial scale would soon lead to disaster. This article has been prepared with a view of assisting orchardists and others who wish to undertake the manufacture of cider in avoiding such results, by aiding them to produce by scientific methods a first-class uniform article, clear and bright, with good flavour and keeping-qualities, which should meet with a ready sale.

Comparatively few people in this country realize what a delicious beverage a well-prepared light cider is, the experience of cider being more generally confined to partaking of one of the numerous concoctions sold under that or similar names, made with artificial flavouring and colouring-materials and artificially carbonated to produce effervescence. The education of the public as to the value of cider as a pleasant drink of low alcoholic strength, and the therapeutic value of dry cider in cases of rheumatism, gravel, gout, and kindred ailments, should be the aim of the cider-maker or merchant when placing the cider on the market.

There are several varieties of cider, both draught and bottled, which differ in their methods of preparation. These are known as dry cider—still or sparkling—in which most of the sugar has been transformed by fermentation into alcohol and carbon dioxide; sweet sparkling cider, in which sufficient sugar remains untransformed; and champagne cider, prepared by the same methods as champagne wine is in France. The manufacture of these different varieties will be explained hereinafter.

THE CHOICE OF APPLES.

The value of New-Zealand-grown apples from a cider-making point of view has not been systematically tested, but excellent cider has been produced from Cox's Orange, Delicious, Sturmer, and Worcester Pearmain apples fermented alone or blended with other varieties.

There is a large field for local experiment in selecting the most suitable varieties and blends of varieties for making cider, and the placing of the acquired results before cider-makers, so that they may have a basis on which to manufacture with a prospect of making a payable article from the beginning, without having to take the risk of experimenting in the early stages.

Apples grown specially for cider will improve if left on the trees as long as possible. It is during the latter part of their vegetative life that their agreeable flavours develop. It is generally conceded that the varieties which mature during the latter part of the season, and whose juice is fermented during the winter months, furnish the highest-grade ciders.

The apples should be ripe, perfectly clean, sound, and free from mould and earthy flavours acquired through lying too long on the ground. The inclusion of a small proportion of overripe apples which are turning brown will not be detrimental to the quality of the cider—in fact, juices in which they are incorporated have a tendency to clear more rapidly than those in which they are omitted. Too large a proportion, however, affects the flavour and makes the cider dark in colour, which is generally considered undesirable.

MATURING AND BLENDING.

To obtain the best results in the palatableness and keeping-qualities of the resulting cider the apples should be milled when the maximum of aroma, flavour, and sugar content is reached—when, in fact, they are at their best for eating purposes.

The skin of the ripe apple should have a dry and slightly wilted appearance, and the pips a dark-brown colour. When the ripe apple is pressed with the thumb it should yield with a slight crackle, but not feel mushy. The ripening process, which includes the transformation of starchy and other matters into sugar, should be followed closely, as there is a considerable difference in the sugar content of partly ripe apples and that of apples which have reached their maximum of ripeness. The density of the juice, which does not quite correspond with the absolute sugar content—though near enough for practical purposes—should be tested with a hydrometer from time to time until no further increase is noticeable, when, other conditions being favourable, the fruit will be ready for grinding. This should not be delayed too long, or the apples will become mushy and the process of extracting the juice more difficult.

Freshly gathered apples are rarely sufficiently ripe or mellow to be converted into cider at once; even the early varieties can be improved by leaving them on the ground, in favourable weather. This, however, should be avoided wherever it is possible to store them under cover, as in rainy seasons the apples may lose some of their saccharine contents and also acquire an earthy flavour, besides being rotted by excessive humidity. Under cover they should be separated from the soil to prevent their being contaminated, and so that the air can circulate freely both underneath and through them. This can be attained in several ways—for instance, by covering the soil with loose boards raised on fairly high cross-pieces, or by covering the floor with a layer of manuka and straw. The apples can be placed in

heaps not deeper than 2 ft., with air-shafts formed of small bundles of manuka placed at intervals to facilitate free ventilation. Apples placed in large piles are liable to heat and ferment. Where bushel cases are available the fruit can be stored in these and placed under cover, with the cases piled up as they are in cool storage. In fact, this will probably be found to be the most convenient and economical method of keeping them. The French cider-makers generally mature their apples in a loft above the cidery, and feed them down to the mill by gravitation. Whichever plan is adopted it will be found advantageous to store each variety and the varieties of each of the ripening-periods separately, so as to facilitate the handling of them when required for the mill.

In the older cider-making countries, among which France leads with an annual average production of 404,118,000 gallons (period 1904-13), special cider apples suited to the climatic and soil conditions are grown. Some of these varieties make good cider by themselves, but the general rule is to blend the different varieties so as to combine the necessary proportions of acid, sugar, and tannin to produce a good keeping and palatable drink. Experience has proved that a better fermentation and resulting cider are obtained in this way than by blending the cider produced from different varieties of apples fermented by themselves, though this course is necessarily followed in blending the ciders made during different ripening-periods or in different years.

The question naturally arises here as to what proportions of sugar, acid, and tannin the juice of an apple should contain to produce a good cider. There is no exact formula of the proportions of the chemical ingredients of apples by following which a good cider can be made. It is known, however, that finished ciders lacking in alcohol, acidity, or tannin are generally of poor quality and flavour, and are subject to deterioration. The composition and amelioration of the finished cider will be considered later.

Good cider can be produced from apples and blends of apples containing very different proportions of sugar, acid, and tannin, and, with the exception of the saccharine contents of the apple-juice, these ingredients are not found in the same proportions or equivalents in the finished cider. It is evident from these considerations that personal taste plays a large part in the selection of suitable apples for blending, and the following approximate composition of the juice of a suitable blend should only be taken as a general guide: Density, 6 to 10 Baumé (1.0434 to 1.0744 specific gravity); total acidity as malic acid, 0.3 to 0.6 per cent.; tannin, 0.2 to 0.5 per cent.*

The best criterion on which to base the choice of apples, and the proper proportions of the different varieties to be used for blending purposes, is furnished by the cider produced from them. It is therefore essential, in order to arrive at manufacturing a standard article, to take note when preparing the apples for the mill of the names and quantity of each variety and their respective qualities, the nature of the soil and situation in which they were grown, and of all other factors

* It is the intention of the writer to later prepare matter for the use of cider makers and wine-makers, giving simple instructions for the analysis of the most important ingredients of fruit-juices and the ciders and wines made from them.

which, in the cider-maker's opinion, are susceptible of modifying the finished product. By comparing the finished ciders the maker can ultimately select a suitable blend of fruit for the manufacture of a high-class cider of distinctive qualities, acceptable to connoisseurs and the majority of consumers. Only those varieties which attain their maximum sugar content at the same period should be blended.

Owing to the difference in climatic conditions the constituents of the same varieties of apples grown on the same soil may vary considerably from one season to another, and the same varieties of apples produce qualities of cider varying with the composition and aspect of the soil the apples were grown on.

MILLING AND PRESSING.

The object of grinding or milling the apples is to rupture the cells containing the juice, so that the maximum of juice can be extracted when the pomace is placed under pressure. Small quantities of apples can be mashed in a tub and the pomace placed loosely in a previously boiled, clean onion-bag, which can either be twisted or placed between two boards and pressed with an improvised lever to extract the juice. Such methods, of course, cannot be considered when it is intended to produce cider on a commercial scale, though for the production of a few barrels the lever principle can be applied by fixing an iron or wooden bar in a hole cut in a tree or in a wall, with the fulcrum placed on the cheese built up of pomace, and the long arm of the lever weighted with a sack of earth or other convenient weight. A press made on this principle should cost very little, and has an advantage over a screw-press in that it keeps up a continual pressure as the juice escapes and the pomace sinks.

Very convenient and compact small hand-operated cider-mills are made, combined with small screw-presses. These are very suitable for producing two or three barrels of juice per day. Larger power-mills and presses, both screw and hydraulic, suitable for factory work, are made, capable of extracting from ten to three hundred barrels of juice per day.

Most of the large commercial cider-makers in England and France use the grater type of mill. These are made with a wooden or metal cylinder fitted with corrugated or saw-like blades, which grate or rasp the apples against a metal concave or shoe, so regulated that the apples are reduced to a finely divided pomace without crushing the pips, which would give an undesirable flavour to the cider.

The old method of building up the cheeses with straw or rushes is seldom employed at the present day. The modern method of building up a cheese consists in placing a rack made of wooden laths or basket-work on the bed of the press, or on the bed of a truck on which the cheese is built up under the mill and run on rails to the press when completed. A square form, 3 in. or 4 in. deep, is placed on the rack, and on this a stout open cloth or netting, made of cotton or some other strong fibrous material, is laid diagonally over the form, allowing the corners to fall over the sides and ends. The pomace is then run into the form. If falling direct from the mill it is liable to pack hard, and should be moved away from the centre to the corners, which should be well filled in. The finished layer of pomace should be quite level.

The corners of the cloth are now folded over the pomace (not too tight), the form raised, and another rack placed on the layer just completed. On this the form is placed and the operation repeated until the cheese is made up. If the cloths are drawn over the cheese too tightly unnecessary strain is placed on the cloths at the edge of the cheese, which will cause them to burst. Care in laying-up the cheese will make it press straight, will prevent injury to the cloths and racks, will make them last longer, and will give a larger yield of juice.

Whichever type of press is used, the pressure should be applied gradually and slowly, in order to allow the juice, which cannot be compressed, to escape. Pressure applied too suddenly will have the effect of hardening the outer layers of the pomace and retaining the juice.

Using a mill of the grater type in combination with a good hydraulic press, a ton of fruit should render about 165 gallons of juice, or a little over 3 gallons to the bushel.

(To be continued.)

FABRAEA-SCALD, FABRAEA MACULATA (LEV.) ATK.*

A FUNGOUS DISEASE OF THE PEAR AND QUINCE.

G. H. CUNNINGHAM, Biological Laboratory, Wellington.

THIS disease is widely spread throughout the world, for it has been recorded from Europe, North America, and Australia. In New Zealand it has been found only on the pear and quince, but in North America it has been recorded in addition on the hawthorn and apple.

ECONOMIC IMPORTANCE.

Fabraea-scald attacks leaves, shoots, and fruits. On leaves it forms spots which, if numerous, may so damage the leaf as to cause it to fall prematurely. Where infection is severe partial defoliation follows, with the result that the crop is reduced the following season. On shoots its effects are generally slight, but in cases of severe infection the laterals may be killed outright, especially at the tips. The chief source of loss is through the fruit, for on them the disease forms large discoloured spots and frequently crevices, which disfigure and render the fruit unsaleable. Through the crevices the spores of secondary fungi enter and cause rapid decay.

Nursery stock is frequently attacked and partially or totally defoliated, consequently infected trees make little or no growth, and are thus rendered unsaleable.

* Synonyms: *Entosporium maculatum* Lev.; black-spot; fruit-spot; leaf-blight; leaf-scald; leaf-spot; quince fruit-spot; scald.

APPEARANCE ON THE HOSTS.

In New Zealand fabraea-scald is common wherever the quince is grown, appearing on the leaf, shoot, and fruit; on pear the trouble is much less common, for although it is not uncommon on the fruit it has seldom been found on the leaf.

On leaves, shortly after they unfold from the bud, the disease appears first in the form of minute, purplish, slightly raised spots on the upper surface (Fig. 1, *b*). In the centre of each spot a small white dot becomes visible—the opening through which the conidia escape. The spots gradually increase in diameter, at the same time changing in colour, and appear on the under-surface of the leaf. They may enlarge until they are about $\frac{1}{4}$ in. in diameter, when they appear at



FIG. 1. QUINCE-LEAVES INFECTED WITH FABRAEA-SCALD NATURAL SIZE.

(*a*) Showing both late and early infection; (*b*) showing early infection.

[Photo by G. H. Cunningham.]

first dark brown, later changing to ashy grey (Fig. 1, *a*), or they may become much larger and more irregular in shape, and reddish-brown in colour. Finally these irregular spots may coalesce and form large irregular areas, which may eventually cover the greater part of the leaf.

In or near the centre of the spots are minute black specks, the fructifications of the fungus. On the leaf-stalks (petioles) small cankers are sometimes formed; when these occur the leaf is killed outright and falls away.

On laterals small, elliptical, somewhat sunken spots are produced. The spots are dark brown, with a slightly lighter-coloured raised margin. These spots may remain small and inconspicuous, and are thus readily overlooked, or they may enlarge until the shoot becomes girdled and dies, becoming then noticeable. Owing to the small size of most of these spots on the shoots, shoot-infection has frequently been overlooked; but this condition plays an important part in the perpetuation of the disease. The significance of this will be discussed later in this article.

On fruits the disease forms spots which differ slightly on different hosts.

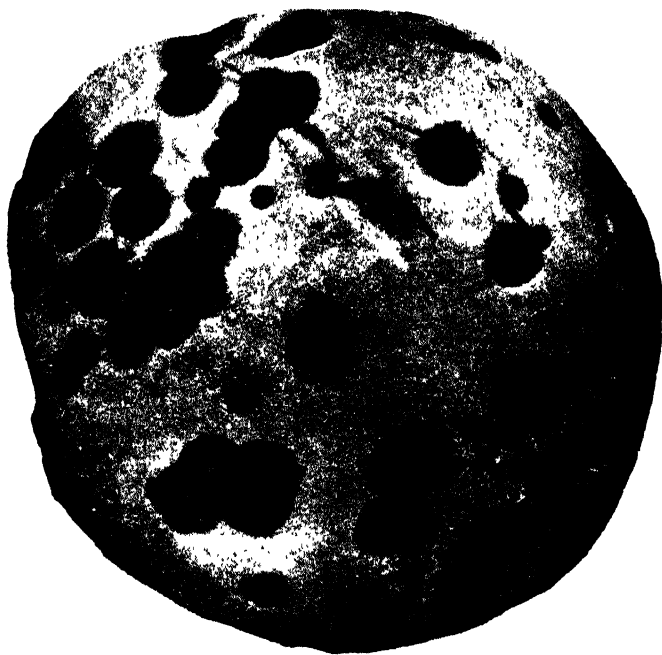


FIG. 2. QUINCE-FRUIT SHOWING SPOTS CAUSED BY *FABRAEA*-SCALD NATURAL SIZE.

Note that the spots are sunken, black, and frequently zoned

[Photo by G. H. Cunningham.]

On pear-fruits the spots are at first small, circular, and a rich carmine. They gradually become black in the centre, and become surrounded by a light reddish-brown zone. At this stage spots superficially resemble those caused by black-spot (*Venturia Pirina*) and are frequently mistaken for them. Finally the surface of the spot becomes roughened and broken, due to the epidermis being raised in the form of a small blister, which is ruptured by the developing fructifications. Frequently the disease forms large irregular cracks on the surface of the fruit; this occurs especially when developing fruits become infected, for the cambium being damaged further growth in the region of the spot is prevented.

On quince-fruits dark-brown or black spots are formed. As these increase in size they become somewhat sunken and darker in colour, and often become zoned. They may attain to a size of $\frac{1}{2}$ in. or more in diameter. These spots may remain isolated, or coalesce to form large irregular areas. In the latter case the fruit usually becomes misshapen and often falls prematurely. Cracking sometimes occurs as in the pear.

Thus on pear the spots are usually small, brightly coloured, and much roughened, while on quince they are dull brown or black, sunken and usually much larger in size.

LIFE-HISTORY OF THE CAUSATIVE ORGANISM.

The disease is caused by *Fabraea maculata* (Lev.) Atk., a fungus possessing two spore-stages in its life-cycle. The first or conidial stage (formerly known as *Entomosporium maculatum* Lev.) is parasitic, occurring on living leaves, shoots, and fruits, forming thereon the discoloured spots described above. The second or ascigerous stage (*Fabraea maculata*) is saprophytic, appearing only on dead leaves which have lain on the ground for some months.

The disease first appears in the spring, shortly after the leaves unfold from the bud. Infection of these leaves would appear to occur either from ascospores produced from fallen leaves in which the fungus has overwintered, or from conidia produced from mycelium which has overwintered in small cankers (spots) on the shoots.

The spores (ascospores or conidia) are carried to the developing leaves by wind or other agency, where, should conditions prove favourable, they germinate and produce a hypha which penetrates the epidermis and enters the tissues, where it forms a mycelium the hyphæ of which derive their food substances from the host-cells. The hyphæ spread outwards and downwards, killing the cells with which they come in contact, the dead cells forming the discoloured spots characteristic of the disease.

After a time the hyphæ form beneath the epidermis a small flattened receptacle (pycnidium) in which the spores are developed. The pycnidium as it develops pushes up the epidermis as a small blister, finally rupturing it and becoming exposed. The pycnidium does not possess an opening (ostiolum) through which the spores emerge, but ruptures irregularly, the ruptured margins standing above the surface of the leaf or fruit, thus giving to the spot the roughened appearance described above. The conidia are so characteristic that their presence is a certain indication that the spots are due to this fungus. Each conidium is four-celled, the cells being arranged in the form of a cross (cruciate). From the free surface of each is produced a fine flagellum (Fig. 3, *f*). The conidia are hyaline and are borne on short stalks (conidiophores) which arise from the base of the pycnidia.

From the first-formed spots spores are produced which infect developing leaves and fruits; conidial infection continues in this manner throughout the growing season. In the autumn infected leaves fall to the ground, and the mycelium within the spots remains dormant until the late winter or early spring, when it produces a second fructification. This appears on the free surface of the leaf as a pale-

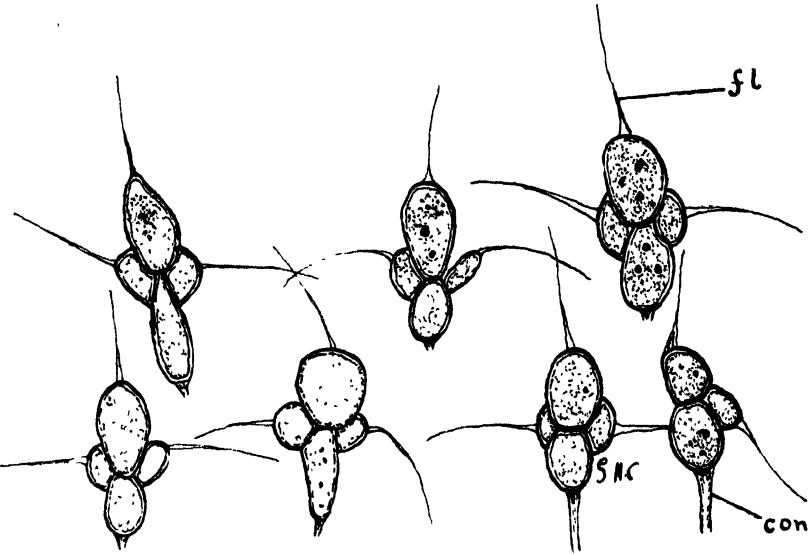


FIG. 3. CRUCIATE CONIDIA OF FABRAEA MACULATA. $\times 1000$.
(fl) Flagellum ; (con) conidiophore. [Original.]

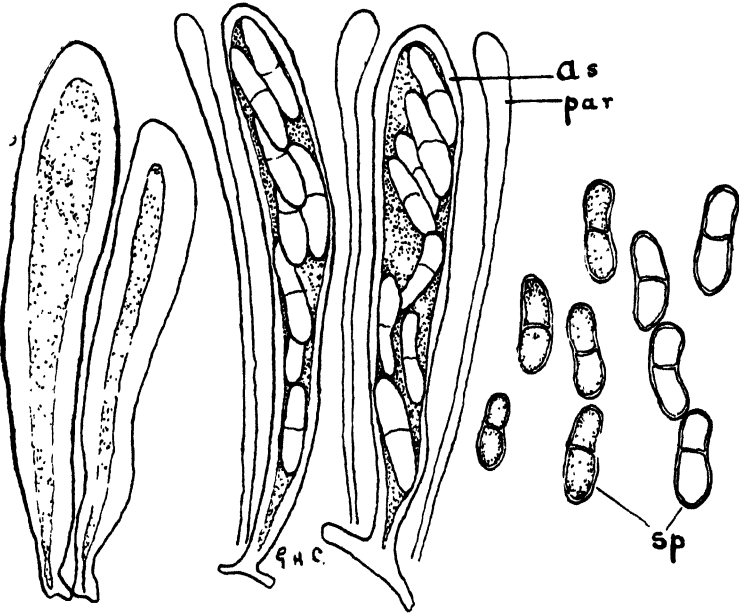


FIG. 4. ASCI, PARAPHYSES, AND ASCOSPORES. $\times 1000$.
(As) Ascus ; (par) paraphysis ; (sp) ascospores. [Original.]

yellow, cup-shaped apothecium so minute as to be barely visible to the eye, being in fact only about $\frac{1}{80}$ in. in diameter. The inner surface of this structure is lined with a closely-packed layer of asci and paraphyses. Each ascus contains eight hyaline two-celled ascospores (Fig. 4).

The connection between the conidial and ascigerous stages has been experimentally proved by Atkinson (1909). He sowed ascospores on culture media and obtained conidia; with the conidia thus produced he inoculated leaves and produced the spots characteristic of this disease.

On account of Atkinson's work it is frequently stated in the literature dealing with this disease that the method of overwintering of the causal organism is by means of resting mycelium in the fallen leaves, this mycelium in the spring producing apothecia and ascospores, the latter infecting leaves as they emerge from the buds. But it would appear that the ascigerous stage is by no means as common as we are led to believe, for during the past spring I have made a continuous search for the ascigerous stage of *fabraea*-scald, but without success. I had leaves, gathered from beneath quince-trees severely infected the previous season, despatched to the laboratory for examination. The first collections were made about three weeks prior to blossoming, and collections continued to arrive at intervals of one week until about the middle of November.* In all, several thousands of leaves were forwarded in all stages of preservation, but in no single instance were either conidia or ascospores obtained from them. Further, all attempts to induce sporulation under artificial conditions failed. While this evidence is not conclusive, it shows that this season at least at Ruakura no ascospores or conidia were produced on fallen leaves, yet the current season's leaves there are all severely infected.

Furthermore, on failing to obtain apothecia in New Zealand, I wrote to several authorities in North America for specimens. In reply they stated that no material was available. Professor H. M. Fitzpatrick, New York State College of Agriculture, Cornell University, stated that apparently this stage has not been collected and recorded since the type material was collected and described by Atkinson (1909). Professor Fitzpatrick kindly loaned me part of the type material, from which the accompanying illustrations of asci and ascospores have been drawn.

Thus we are led to seek another means whereby the fungus is able to overwinter. It is improbable that the conidia are able to live through the winter months on the fallen leaves, for none were present on the many leaves examined.

Several authorities claim that the mycelium in infected twigs is perennial, and that this mycelium in the early spring produces conidia which infect the developing leaves. Although conclusive evidence of this is wanting it is probable that such is the case, for it is obvious that some such additional source of infection is necessary in order to account for the heavy infection that occurs at blossoming-time, and we have already seen that the ascigerous stage is apparently rare.

* The writer is indebted to Mr. T. Roach, Horticultural Overseer, Ruakura Farm of Instruction, for the collection and forwarding of this material.

CONSIDERATIONS REGARDING CONTROL.

From a consideration of the foregoing it would appear that there are two probable methods whereby this organism may overwinter—(1) by resting mycelium overwintering in the fallen leaves (producing apothecia and ascospores in the spring), and (2) by resting mycelium in the shoots (producing conidia in the spring).

Thus control measures would consist firstly in the removal of these sources of infection, and secondly in the prevention of infection by coating developing leaves and fruits with some suitable fungicide. It would be difficult to detect the cankers on laterals, so that the removal of such infected shoots is not stressed; but in order to minimize this source of infection it is suggested that quince-trees be regularly pruned, all weakly growth removed, and the trees opened out in such a manner as to facilitate spraying—for too often these trees are neglected. And it must be borne in mind that the fungus may spread from quince to pear, consequently it is essential that the quince-trees be not overlooked during pruning and spraying operations.

To minimize infection from fallen leaves it is suggested that the orchard be ploughed in the late autumn after all the leaves have fallen, and that all portions beneath the trees not reached by the plough be turned over with a spade.

CONTROL.

As in essentials the life-history of fabraea-scald is very similar to that of apple and pear black-spot, it follows that remedial treatment would be of a similar nature. Thus, in addition to pruning and ploughing, the following spray schedule is recommended:—

No.	Time of Application.	Spray.
1	Green-tip	5 4 50 bordeaux, or 1 10 lime-sulphur.
2	Between open-cluster and pink stage	3-4 50 bordeaux, or 1-10 lime-sulphur.
3	Calyx-spray (petal-fall or when majority of petals have fallen)	1-100 to 1-120 lime-sulphur.
4	Ten days later	1-100 to 1-120 lime-sulphur.
5	Every month until the fruit reaches maturity	1-100 to 1-120 lime-sulphur.

As this is the schedule recommended for pear black-spot control it follows that where the latter disease is prevalent in a district no further spray treatment will be required in order to combat fabraea-scald on the pear host.

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LUCERNE AS A PROTECTION AGAINST FIRE.

THE value of lucerne for fire-break purposes was strikingly demonstrated last month at Ben Morven, Marlborough, in which district a prolonged spell of dry weather had been experienced. The Ben Morven seed-farm, which is devoted mainly to the production of lucerne-seed, is situated on an extensive stretch of cropping-land, at the foot of hills covered with danthonia. At the time in question the danthonia grassland was exceedingly dry, while in the vicinity of the farm were hundreds of stacks of early oats grown for chaff.

Under these conditions a fire which broke out on 9th January in the farm apiary, with a north-west wind blowing, threatened to sweep miles



OUTBREAK OF FIRE AT BEN MORVEN SEED-FARM.

The lucerne-field which checked the fire is situated behind the willow-trees, the danthonia-covered hills being in the background.

of grassland and destroy much valuable harvested crop. The wind carried the flames straight towards the danthonia hills, but, thanks to a lucerne-field which intervened, it was possible to keep the fire under control, and little actual damage resulted.

In the drier districts, where grass-fires are liable to occur, the establishment of protection belts of lucerne at suitable points is well worth the consideration of farmers. They may be regarded as a form of fire insurance, apart from their value for forage and grazing purposes. Proper management as regards cutting, &c., would, of course, be necessary.

—F. W. Greenwood, *Instructor in Agriculture, Blenheim.*

Royal Agricultural Society.—An Order in Council gazetted on 12th January formally incorporated the Royal Agricultural Society of New Zealand.

TESTING OF PUREBRED DAIRY COWS.

REVIEW OF THE NEW ZEALAND C.O.R. SYSTEM IN 1923.

W. M. SINGLETON, Director of the Dairy Division.

DURING the calendar year under review climatic conditions in the Dominion have been somewhat abnormal from the dairying point of view, an almost perfect dairying autumn and a mild winter generally being followed by an exceptionally dry period in late spring and early summer. The performances of purebred cows under certificate-of-record test have naturally been more or less affected according to the date at which they completed their lactation period, those finishing early in the spring having a distinct advantage over the later calvers. Nevertheless, the yield of the average cow under test has been well maintained, and so far as individual records are concerned it has been an exceptional year. Two cows, a Jersey and a Friesian, have received certificates on productions exceeding 1,000 lb. of butterfat, and of the twenty-three classes into which the breeds participating in the C.O.R. testing are as a whole subdivided no less than twelve of the previous class-leadership yields have been exceeded.

CERTIFICATES ISSUED.

The total number of cows which have received first-class certificates since the commencement of the C.O.R. system now stands at 3,389. The highest number of certificates issued during 1923 went to the Jerseys, that breed being represented by 569 cows, of which 518 were on first performance. In total certificates this represents an increase of 172 certificates over the number issued to the breed for the previous year. The Friesians, with 162, show a slight decrease, while the other breeds represented stand about the same as for 1922. The following table gives particulars of certificates issued since the commencement of the system:—

Breed.	1913.	1914		1915		1916		1917		1918		1919		1920		1921		1922		1923.	
		Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.	Ordinary.	Repeat.
Jersey ..	67	104	14	91	4	94	11	94	13	113	8	150	14	227	33	339	49	351	46	518	51
Friesian ..	48	67	11	62	9	44	5	62	14	57	14	54	7	82	23	128	25	136	32	130	32
Milking Shorthorn ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Ayrshire ..	2	15	1	12	1	9	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Red Poll ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Shorthorn ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
Totals ..	117	186	26	167	14	154	16	181	31	196	22	259	24	373	58	519	88	543	88	693	93

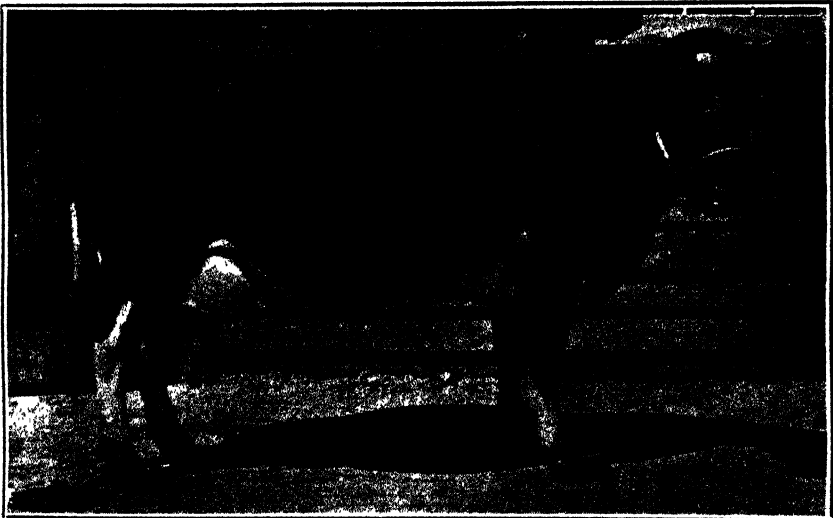
FRIESIANS.

Class-leaders.

In the Friesian class-leaders only one change has been made from last year's list—Bainfield 27th (see *Journal* for November last) going to the head of the senior four-year-olds in place of Buttercup

3rd of Ashlynn. When it is kept in mind, however, that the records for this breed range from 740.50 lb. butter-fat in the junior two-year-old class to 1,145.24 lb. fat for the mature class-leader, it must be recognized that further changes in the list will be slower in coming than in the past. The table for 1923 is as follows:—

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days	Milk.	Fat
<i>Junior Two-year-old.</i> Monavale Queen Bess	T. H. Richards, Cardiff	Yrs. dys 2 16	lb. 242.1	365	lb. 20,501.1	lb. 740.50
<i>Senior Two-year-old.</i> Netherland Princess 4tl	John Donald, Westmere	2 34	274.6	365	19,621.6	805.77
<i>Junior Three-year-old.</i> Monavale Queen Bess	T. H. Richards, Cardiff	3 56	282.6	365	21,609.3	800.18
<i>Senior Three-year-old.</i> Manor Beets Daughter 2nd of Ashlynn	C. A. Hopping, Palmers ton North	3 29	306.6	365	18,733.9	863.51
<i>Junior Four-year-old.</i> Westmere Princess Pietertje	John Donald, Westmere	4 15	329.1	365	24,199.0	939.78
<i>Senior Four-year-old.</i> Bainfield 27th	C. H. Potter, Pukerau	4 35	348.6	365	23,203.3	910.74
<i>Mature</i> Alcartra Clothilde Pietje	Vernon Marx, Manga- toki	7 35	350.0	365	31,312.5	1,145.24



BAINFIELD 27TH (C. H. POTTER, PUKERAU).
Leader of the Friesian senior four-year-old class.

Friesian Class-averages.

Six out of the seven classes into which the Friesian breed is divided show increases over the respective class-averages for the previous year. The only class showing a decrease is the junior three-year-old, but it is to be remembered that so small a class—only fifteen cows—is strongly affected in the average by individual records. The 1922 junior three-year-old class contained some outstanding individuals, while 1923 has been less marked in that respect. During the year eight Friesians yielded over 800 lb. of butterfat, of which one exceeded 900 lb. and one 1,000 lb.

The total number of Friesians which gained certificates in 1923 was 162, while in the previous year the number was 168. To the end of 1923 the total number of certificates issued to Friesians was 1,042, and the average yield 463·88 lb. butterfat from 13,116·3 lb. milk in 343 days. For 1923 the 162 certificates issued were on an average yield of 14,752·3 lb. milk, containing 515·62 lb. butterfat, in an average milking-period of 350 days, an increase of 9·53 lb. butterfat over the previous year.

The class averages for 1923 and 1922 are given in the following table:—

Class	Number of Cows.	Average Yield for Season.		
		Days in Milk.	Milk.	Fat.
		1923.	lb.	lb
Junior two-year-old ..	50	345	11,435'4	406'27
Senior two-year-old ..	16	348	14,343'4	497'45
Junior three-year-old ..	15	347	12,572'7	445'21
Senior three-year-old ..	11	355	16,253'1	583'27
Junior four-year-old ..	12	353	15,885'1	551'06
Senior four-year-old ..	17	357	17,516'6	604'07
Mature	41	353	17,878'2	616'19
		1922.		
Junior two-year-old ..	67	343	11,421'1	404'32
Senior two-year-old ..	15	352	12,382'3	419'29
Junior three-year-old ..	14	358	15,779'2	528'94
Senior three-year-old ..	17	345	14,228'2	480'59
Junior four-year-old ..	9	346	14,361'6	508'51
Senior four-year-old ..	8	346	16,423'1	571'56
Mature	38	341	15,615'3	541'40

Friesian C.O.R. Bulls.

A bull is classed as a C.O.R. bull when he has sired four or more certificated daughters, each from a different dam. The Friesian C.O.R. bulls now total sixty-seven, fourteen new names having been added during the year under review. These sixty-seven bulls have a total of 490 C.O.R. daughters to their credit, which represents over

50 per cent. of the total certificates issued to the cows of the breed. Cliffside Laddie and King Segis Wild Rose Homestead have each added a daughter during the year, and remain at the head of the list with a strong tally of twenty C.O.R. daughters each. Following is a list of the bulls :—

Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1923.	Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1923.
Cliffside Laddie ..	20	0	Black and White King of Ashlynn*	5	4
King Segis Wild Rose Homestead ..	20	1	Colantha Pontiac ..	5	1
Woodcrest Joe ..	18	0	Colantha Johanna Lad	5	0
King Fayne Segis 2nd	16	1	Colantha Pietertje	5	0
Sir de Kol Inka Pie- tertje ..	16	0	Count de Kol		
Prince Pietje Paxton	14	2	Dominion de Kol Do- mino ..	5	0
Woodcrest Hengerveld	14†	1	Dominion Dutchland	5	0
Mechthilde ..			Friesland Dirk* ..	5	2
De Kol Pontiac Burke	13	1	King of the Black and Whites ..	5	1
Kruger 2nd ..	13	0	King Alcartra Rose de Kol ..	5	1
Paul Pietertje ..	13	0	Longbeach Big Patch	5	1
Bainfield Dutchman	11‡	3	Medbury Prince ..	5†	1
Longbeach Van Tromp	11	0	Marquis Segis Colan- tha*	5†	3†
Grace's Netherland of Riverside ..	10	0	Rex de Kol of Sunny- croft ..	5	0
Mutual Piebe of Rock	10	0	Salma Torohunga No. 1	5	0
Nazli de Kol ..	10	0	Woodcrest Johanna Pontiac ..	5	0
King of Dominos ..	9	3	Canterbury King of Kingsbrook*	4	1
Mutual Piebe de Kol	9	0	Colantha Johanna ..	4	0
Netherland King of Rosevale ..	9	1	Cordylinc Hero* ..	4	2
Longbeach Primrose League ..	8	0	Dominion Domino	4	0
Mutual Mercedes Pie- tertje ..	8	2	Dutch Boy ..	4	4
Rosevale Korndyke	8	2	Friesland Gem* ..	4	0
Sylvia Posch ..	8	3	Friesland Colantha Lad	4	0
Royal King Champion	8	0	Friesland Park von Bulow*	4	1
Sir Colantha Korndyke	8	1	Holland Queen's Son	4	0
Rag Apple ..	8	0	Indi Paul of Lakeside	4	0
Woodcrest Pietje Pon- tiac ..	8	1	King Laddie* ..	4	1
Edinglassie ..	7	0	King Segis of Friesland Park ..	4	0
Dominion Oak de Kol	7	0	Longbeach Dutchman	4	0
2nd Homestead			Longbeach Major ..	4	0
Fobes ..			Marquis Piebe de Kol*	4	4
Rosevale King Sylvia*	7*	4*	Netherland King ..	4	0
Bainfield Prince ..	6	0	Oakwood Holland King ..	4	0
Colonel Manor of River- side ..	6	0	Pietertje Boy ..	4	0
Cordylinc Colantha Hero*	6	4	Pareora Bindal ..	4	0
Dominion Woodcrest	6	4	Rozine's Butterboy ..	4	0
Piebe Mercedes*			Soldene Grace* ..	4	2
Felix de Kol of Mona- vale*	6	4			

* First entry of bull on list. ‡ Also one second-class certificate daughter.

JERSEYS.

Class-leaders.

During the year four out of the five classes into which the Jersey breed is subdivided have had the previous highest yield for the class exceeded. The only previous record which remains is that of Mr. A. J. Smith's St. Lambert's Bell, leader of the four-year-olds, while the outstanding new performance is that of Pretty's Flirt, whose yield of 1,010·49 lb. of butterfat in the mature class (constituting her champion Jersey cow of New Zealand) will be difficult to displace. Pedigree notes and general comment on all four new leaders were published in the *Journal* for November and December last. The class-leaders as they stand at the close of 1923, are as follows:—

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate	Yield for Season		
				Days.	Milk	Fat.
<i>Junior Two-year-old</i>		Yrs. dys.	lb.		lb.	lb.
Alfalfa Pansy ..	F. J. Saxby, Hamilton	2 4	240·9	365	10,898·1	690·16
<i>Senior Two-year-old.</i>						
Marshland's Stylish Princess	W. J. Chynoweth, Hamilton	2 353	275·8	365	9,927·7	715·75
<i>Three-year-old.</i>						
Zola of Rosy Creek ..	E. Joyce, Kaponga ..	3 43	281·3	365	12,478·6	741·20
<i>Four-year-old.</i>						
St. Lambert's Bell ..	A. J. Smith, Cardiff ..	4 283	341·8	365	14,423·1	780·32
<i>Mature.</i>						
Pretty's Flirt ..	W. H. Miers, Rukuhia	6 353	350·0	365	16,684·1	1010·49



PRETTY'S FLIRT (W. H. MIERS, RUKUHIA, HAMILTON).

Leader of the Jersey mature class and champion cow of the breed in New Zealand.

Jersey Class-averages.

The Jersey classes for 1923 include the records of 569 cows, as against 397 for the previous year. With the exception of the four-year-old all classes are considerably stronger numerically, the largest increases, as might be expected, falling to the junior two-year-olds and the mature cows. The junior two-year-olds have increased by sixty-two, and, despite the large percentage of cows whose records fall into this class, the average of all certificates issued to the breed since the commencement of the system has increased (for the year) by 8.31 lb. butterfat, bringing the present average yield to 428.52 lb. butterfat, in an average milking-period of 343 days for 2,391 certificates issued.

For 1923 the average C.O.R. Jersey yielded 455.13 lb. butterfat, from 8,177.4 lb. milk, in 348 days; the corresponding averages for 1922 were 443.75 lb. butterfat, from 8,007.5 lb. milk, in 344 days. Individually as well as collectively the class-averages have increased. Regarding the junior two-year-old class, it may be stated that the average age at commencement of test was 1 year 353 days. Thus, working on the usual basis of 240.5 lb. butterfat as minimum standard, the average of 238 heifers in this class was 157.32 lb. butterfat above the requirement for certificate.

The figures for 1923, together with those for 1922, are as follows:—

Class.		Number of Cows.	Average Yield for Season.		
			Days in Milk.	Milk.	Fat.
1923					
Junior two-year-old	..	238	348	7,122.7	397.82
Senior two-year-old	..	63	344	7,991.2	457.13
Three-year-old	..	99	350	8,636.8	482.08
Four-year-old	..	45	345	9,044.9	499.06
Mature	..	124	350	9,614.4	526.63
1922.					
Junior two-year-old	..	176	342	6,950.4	390.17
Senior two-year-old	..	41	350	7,815.2	427.75
Three-year-old	..	57	337	8,342.8	462.10
Four-year-old	..	37	348	8,869.7	498.37
Mature	..	86	349	9,669.5	525.38

Jersey C.O.R. Bulls.

The list of Jersey bulls which have qualified for the C.O.R. class now includes 140 names, representing 1,113 cows, or more than 50 per cent. of the cows of the breed which have gained certificates. On account of the large number of names involved it is impossible to make individual comment. The Jersey Cattle Breeders' Association, however, has what they name a champion butterfat bull class, and four of the bulls in the appended list are entitled to inclusion in this class. In order to qualify a bull must have five certificated daughters from different dams, each daughter at least doubling her butterfat requirement for certificate. The four bulls referred to are Bilberry's Twylish, with seven such C.O.R. daughters; Belvedere Sun Prince, six daughters; Grannie's Knight, seven daughters; and Sunflower's Perseus, five

daughters. The conditions are severe, and those bulls successful in qualifying for this class may be considered as outstanding animals which have demonstrated their power of prepotency, one of the most desirable qualities of a dairy sire.

Following is the complete list of Jersey C.O.R. bulls:—

Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1923.	Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1923.
Eminent's Fontaine ..	33	5	Oculist 12th ..	8	0
Grannie's Knight ..	31†	17†	Peggy's Campanile ..	8†	0
Majesty's Fox ..	30	0	Rainbow's King ..	8	3
K.C.B. ..	28	2	Admiral ..	7	2
Sultan's Disdain ..	26†	12†	Beachland's Com- mander* ..	7	6
Noble Twylish ..	20	5	Brighton Twylish ..	7	0
Fancy's Lord Twylish	21	2	Blizzard ..	7	0
Roberts ..	19	0	Charm's Lord ..	7†	2
Admiral of Puketapu	19	2	Eileen's Fox* ..	7	3
Belvedere Sun Prince	18†	5†	Goddington ..	7	0
Proud Fox* ..	15†	13†	Genoa Nelson Chase	7	2
Golden Swan ..	13	2	Masterpiece of Meadow brook ..	7	1
Holly Bank Squire ..	13	8	Maid's General ..	7†	1
Mona's Ally ..	13	7	Marcus ..	7	1
Bilberry's Goddington	12	0	Silverlock's Duke ..	7	2
Neathead's Majesty*	12†	9†	Stevenson ..	7	0
Sunflower's Perseus ..	12	0	Twylish Hope ..	7	2
The General ..	12†	1†	Belvedere Sunset ..	6	0
V.C. ..	12	5	Beachland's White Swan* ..	6	5
Exile of Oaklands ..	11†	4	Belvedere Butter Boy	6	0
Good Luck ..	11	1	Flower Boy 2nd ..	6	2
Renown of Meadow- brook ..	11	2	Grannie's Campanile Sultan* ..	6	3
Sweet Fox of Colling- wood ..	11	5	Golden Fox 2nd ..	6	0
Te Rapa Lad* ..	11	8	Grand Duke ..	6	0
Bilberry's Twylish ..	10†	4	Maori Captain* ..	6	5
Campanile's Sultan ..	10	0	Meadowbrook Nobility	6	0
Farleigh Fox ..	10†	1	Mabel's Dairyman ..	6	0
Lady's Duke ..	10†	1	Mountain View's Rioter* ..	6	3
Molina's General ..	10	2	Oakvale's Red Line ..	6†	1
Rainbow ..	10†	0	Pride of Egmont ..	6	0
Soumise Tom ..	10	2	Sherry's Fox of Col- lingwood* ..	6	4
Viola's Golden Laddie	10	4	Sunglow* ..	6	2
Belvedere Bilberry's Last ..	9	3	Belvedere Star* ..	5	2
Bush Boy ..	9†	1†	Blondin ..	5	0
Charm's Lord Twylish	9	0	Eileen's Fox 2nd* ..	5	5
Lord Twylish ..	9	1	Flandrine's Swan ..	5	1
Mermaid Sultan ..	9	1	Gavotte's Hero ..	5†	+
M.L.C. ..	9	0	Hawkesbury Black Prince ..	5	0
Petune's Noble ..	9†	2†	Ivondale's Rainbow*	5	4
Rozel's Sultan ..	9	0	Juno's Laddie ..	5	0
Soumise Majesty ..	9	0	King Twylish* ..	5	2
Sunlight's Noble Gene- ral ..	9	2	Lord Nelson ..	5†	0
Starbright ..	9	0	Lord Lepperton ..	5	0
The Owl's Victor ..	9†	1	Lord Gambo* ..	5†	2
Belvedere Jersey Boy	8	3	Mona's Campanile ..	5	0
Friskey Campanile ..	8	0	M.H.R. ..	5	0
Hawksbury Emperor	8	1			
Heather Boy ..	8	0			
Miro Meadow Star ..	8	4			

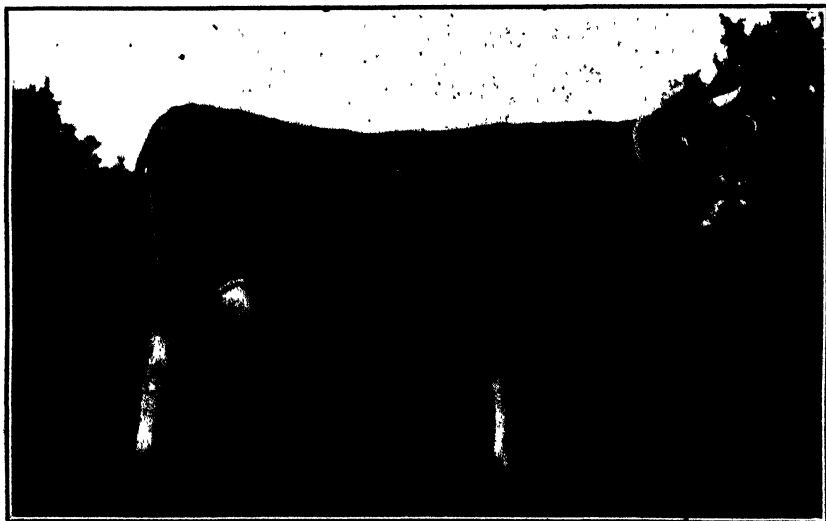
JERSEY C O.R. BULLS—*continued*.

Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1923.	Name of Bull.	Total of C.O.R. Daughters.	Number of Daughters qualified during 1923.
Miro Meadows Maori Boy	5	0	Fancy Carnation's Fox	4	0
Protection of Meadow- brook	5	0	General Noble*	4	1
Rose's Attraction's Fox*	5	5	Golden Swan's Lad*	4	4
Silver Conqueror ..	5	1	Glory ..	4	0
Senor ..	5	1	Knight Commander ..	4	0
Shamrock of Beach- lands*	5	3	Lord Maitland ..	4	0
Silver King (Stuckey's)	5	0	Mayflower Magnet 2nd	4	0
Signor* ..	5	3	Maid's Noble General	4	0
The Squire (1272) ..	5	0	Melia Ann's Sultan ..	4†	0
Briar's Twylsh*	4	2	Meadowvale Conqueror*	4	3
Butterman Lad ..	4	0	Mere's Conqueror* ..	4	2
Black Swan ..	4	0	Miro Meadow's Dick*	4	4
Belle's Archlight Knight*	4	1	Miro Meadow's Paddy*	4	2
Belvedere Sun King*	4	1	Napper* ..	4	2
Bonnie Mac* ..	4	4	Nestor of Willowbank	4	0
Brentwood Gallant*	4	1	Noble Sultan* ..	4	2
Chief of Jersey Mea- dows*	4	3	Noble Warder ..	4	0
Defender of Meadow- vale	4	0	Prince Enid* ..	4	1
Floss's Starlight* ..	4	1	Rarity of Meadow- brook*	4	1
Fairy's Campanile ..	4	0	Shamrock's Sweet Lad*	4	4
			Starlight 2nd ..	4	0
			Una's Nobility ..	4	0
			Vulpes of Bulls* ..	4	1
			Yankee Sweet ..	4	0
			Young Emperor 3rd	4	0

* First entry of bull on list.

† Also two second-class-certificate daughters.

‡ Also one second-class-certificate daughter



MARSHLANDS STYLISH PRINCESS (W. J. CHYNOWETH, HAMILTON).

Leader of the Jersey senior two-year-old class.

MILKING SHORTHORNS.

Class-leaders.

The year 1923 has brought four changes to the leaderships of the seven classes of the Milking Shorthorn breed. As with the new leaders of other breeds, notes have appeared in the *Journal* regarding the performances of these four record-breakers. Although the highest class-leaders for this breed fall considerably short of the best performances of the Jerseys and Friesians, their records are nevertheless very creditable, and it is pleasing to note an upward tendency from year to year. The list is as follows:—

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat required for Certificate.	Yield for Season.		
				Days.	Milk.	Fat.
<i>Junior Two-year-old.</i> Matangi Quality 4th	Ranstead Bros., Matangi	Yrs. dys. 2 109	lb. 251·4	365	lb. 14,572·8	lb. 591·89
<i>Senior Two-year-old.</i> Birkland Dainty ..	G. N. Bell, Palmerston North	2 281	268·6	365	11,616·9	459·98
<i>Junior Three-year-old.</i> Dominion Carnation of Ruakura	Ruakura Farm of Instruction, Hamilton East	3 9	277·9	348	9,942·6	439·20
<i>Senior Three-year-old.</i> Matangi Ruth 2nd ..	Ranstead Bros., Matangi	3 304	307·4	365	14,032·7	747·86
<i>Junior Four-year-old.</i> Matangi Nancy 2nd ..	Ranstead Bros., Matangi	4 3	313·8	365	15,591·6	608·28
<i>Senior Four-year-old.</i> Sweet Garnett 2nd of Cornwall Park	R. S. Allan, Hatuma..	4 359	349·4	365	16,260·3	514·19
<i>Mature.</i> Maniaroa Princess ..	Ranstead Bros., Matangi	..	350·0	365	15,951·7	700·76

Milking Shorthorn Class-averages.

Of the seven classes into which the Milking Shorthorn breed is divided only two—the junior two-year-old and the mature—offer any opportunity for comparison with the previous year's results. Of the remaining classes the junior three-year-old and the junior four-year-old have only two representatives, and each of the others only one. The junior two-year-old class comprises six records, and these average 459·69 lb. butterfat, an increase of approximately 145 lb. over six records in the same class for the previous year. In the mature class eight cows in 1922 averaged 444·28 lb. butterfat, and in 1923 sixteen cows in the same class are credited with an average yield of 474·65 lb. Thus each class shows a considerable increase in average production. The thirty Milking Shorthorns which gained certificates during the year

had an average yield of 11,737·1 lb. milk, containing 463·25 lb. butter-fat, in an average milking period of 343 days.

The class-averages for this breed for 1923 and 1922 are as follows :—

Class.	Number of Cows	Average Yield for Season.		
		Days in Milk	Milk.	Fat.
		1923.	lb.	lb.
Junior two-year-old ..	6	352	12,145·8	459·69
Senior two-year-old ..	2	336	8,750·3	337·39
Junior three-year-old ..	2	301	7,945·4	300·97
Senior three-year-old ..	1	365	14,032·7	747·86
Junior four-year-old ..	2	365	12,802·0	494·14
Senior four-year-old ..	1	365	16,260·3	514·19
Mature ..	16	340	11,860·7	474·65
		1922.		
Junior two-year-old ..	6	358	7,681·4	314·27
Senior two-year-old ..	4	331	8,085·0	312·84
Junior three-year-old ..	4	326	9,238·0	378·51
Senior three-year-old ..	2	333	9,257·2	358·26
Junior four-year-old ..	2	340	9,599·2	368·14
Senior four-year-old ..	1	365	10,963·1	418·04
Mature ..	8	340	11,200·3	444·28



MATANGI RUTH 2ND (RANSTEAD BROS., MATANGI).

Leader of the milking Shorthorn senior three-year-old class, and champion cow of the breed in New Zealand.

Milking Shorthorn C.O.R. Bulls.

The Milking Shorthorn bulls which have qualified for the C.O.R. class now number three. The outstanding bull is Dominion Esau of Ruakura, bred by the Department of Agriculture at the Ruakura Farm of Instruction, Hamilton. He now has six daughters to his credit, including Matangi Quality 4th, with 591·89 lb. butterfat as a junior two-year-old; Matangi Nancy 2nd, with 608·28 lb. as a junior four-year-old; and Matangi Ruth 2nd, the New Zealand champion of the breed, with 747·86 lb., as a senior three-year-old. All three of these high producers are owned by Messrs. Ranstead Bros., of Matangi. Each of the other two bulls of the breed to qualify—Orakau Legislator and Dilworth Baronett—has four C.O.R. daughters.

AYRSHIRES.

Class-leaders.

The list of Ayrshire class-leaders shows three changes from last year, Mr. W. Hall's two-year-old, Dimple of Edendale, going to the head of her class, and Ivanhoe Fancy and Ivanhoe Fillpail taking the lead of the four-year-old and mature classes respectively. Some comment on Dimple of Edendale appeared in the December *Journal*, while the other two animals just mentioned make their first appearance in the *Journal* in the appended closing list for 1923. Some brief pedigree notes concerning them are also given in connection with the list. The table of class-leaders is as follows:—

Name of Cow and Class	Tested by	Age at Start of Test.	Fat req'd for Cert	Yield for Season		
				Days.	Milk.	Fat
<i>Two-year-old.</i>		Yrs dys.	lb.		lb.	lb.
Dimple of Edendale	W. Hall, Lepperton ..	2 327	273·2	365	13,063·3	529·46
<i>Three-year-old.</i>						
Greenfield's Ina ..	C. E. C. Webb, Koputaroa	3 345	311·5	365	13,958·3	566·02
<i>Four-year-old.</i>						
Ivanhoe Fancy ..	A. M. Weir, Menzies Ferry	4 308	344·3	365	14,207·7	713·93
<i>Mature.</i>						
Ivanhoe Fillpail ..	A. M. Weir, Menzies Ferry	..	350·0	365	16,362·7	646·31

Ayrshire Class-averages.

Twenty Ayrshire cows gained certificates during the year. These twenty animals gave an average yield of 498·76 lb. butterfat, from 11,865·5 lb. milk, in 359 days. It is pleasing to be able to report an increase over the preceding year for each of the four classes into which the Ayrshire breed is divided. The extent of the increases will be seen in the following table:—

Class.		Number of Cows.	Average Yield for Season.		
			Days in Milk.	Milk.	Fat.
		1923.		lb.	lb.
Two-year-old	.. ..	4	365	10,986·1	438·63
Three-year-old	.. ..	2	365	11,036·2	458·40
Four-year-old	.. ..	4	365	11,166·2	500·52
Mature	.. ..	10	353	12,663·0	530·19
		1922.			
Two-year-old	.. ..	4	342	8,981·7	384·71
Three-year-old	.. ..	6	348	8,679·1	368·27
Four-year-old	.. ..	2	354	11,266·9	487·55
Mature	.. ..	11	345	11,797·2	486·58

Ayrshire C.O.R. Bulls.

For several years the Ayrshire breed had only one name in the C.O.R. bull class, that of King Cole. It is pleasing now to be able to record five bulls in this class. They are as follows: Dominion Netherton Good Bonus, seven C.O.R. daughters; King Cole, six daughters; Ben of Glenariff, four daughters; Jewel Prince of Wai-papa, four daughters; Maesgwyn Prince, four daughters. Now that the Ayrshire breed is securing so many fine records it is to be hoped that breeders will not be so tardy in entering their cows for C.O.R. test, and it is trusted that next year the list of bulls will be considerably lengthened.



IVANHOE FANCY (A. M. WEIR, MENZIES FERRY).

Leader of Ayrshire four-year-old class, and champion cow of the breed in New Zealand.

RED POLLS.

Four Red Polls gained first-class certificates-of-record during the year, and all are from the Central Development Farm herd of the Department of Agriculture at Weraroa. Individual records were published in last month's *Journal*. Each animal passed by a satisfactory margin the minimum butterfat requirement for her class. Two junior two-year-olds (one calving under two years of age) averaged 323.65 lb. butterfat, a junior three-year-old gave 322.99 lb. butterfat in 300 days, and a mature cow 468.40 lb. in 335 days.

SECOND-CLASS CERTIFICATES.

The second-class certificates-of-record issued during 1923 were distributed as follows: Jerseys, 21; Friesians, 6; Milking Shorthorns, 2; and Ayrshires, 1; making a total of 30. This number is so small, comparatively, as to represent an almost negligible percentage of the total certificates issued. It would appear, therefore, that breeders are making every endeavour to have their cows comply with the rule which provides that in order to gain a first-class certificate a cow must calve within fifteen months after the date of calving for commencement of test.

EXPORT OF PUREBRED DAIRY CATTLE.

The exports of purebred dairy cattle for 1923 totalled 203 animals, valued at a total of some £8,650. This represents an increase in numbers of 88, although in value there is an increase of only about £150. This lower average value is probably partly accounted for by the general decline in cattle values, and partly because a large proportion of the stock exported was comprised of calves and untested heifers. Judging by the figures for the past several years it would seem that New Zealand has now established the foundation of a fairly substantial export trade in dairy cattle. While we regret the loss of so many fine beasts, it is pleasing to recognize that the bulk of the stock leaving the country is of such quality as to build a sound reputation for New Zealand purebreds in the importing countries.

APPRECIATION.

The measure of success which has been attained by the C.O.R. testing has been largely contributed to by the co-operation of the several breeders' associations, of which the testing breeders are members. Much of the work of the breeders' associations in this connection must necessarily devolve on their secretaries. The Dairy Division's cordial acknowledgment of valued assistance cheerfully rendered is due to Messrs. W. M. Tapp, secretary, New Zealand Jersey Cattle Breeders' Association; J. M. Thomson, secretary, New Zealand Friesian Association; William Hunter, secretary, New Zealand Milking Shorthorn Breeders' Association; and R. H. Spencer, secretary, New Zealand Ayrshire Cattle Breeders' Association.

CLOSING LIST OF RECORDS FOR 1923.

The appended list was intended to finish the publication of records completed during the calendar year 1923. Owing, however, to the tardiness of some breeders in returning forms of declaration of milk-weights, &c., it may be necessary to publish a few outstanding names in a subsequent list.

Apart from Pretty's Flirt, whose record of 1,010 lb. butterfat has been previously noticed, the outstanding feature of this closing list is the appearance of two new class-leaders for the Ayrshire breed. Ivanhoe Fancy, with her fine performance of 713·93 lb. butterfat, becomes not only leader of the Ayrshire four-year-olds but champion of the breed in New Zealand. Ivanhoe Fillpail, in the mature class, has gained a certificate for 646·31 lb. butterfat, entitling her to the leadership of that class. She has also achieved the distinction of having given the highest milk-yield—16,362·7 lb.—for any Ayrshire yet certificated in the Dominion. These two animals are herd-mates and half-sisters, and are owned by Mr. A. M. Weir, of Menzies Ferry, Southland. They are the only two certificated daughters of Hindsward Jimmy of Townhead, who is by the imported bull Oxhill Jimmy. The dam of Ivanhoe Fillpail is Ivanhoe Curly 2nd, who has not been tested, but is sired by King Cole, a well-known Ayrshire bull who has sired six C.O.R. daughters, including Minnie of Glenweir, who has a certificate for 528·92 lb. butterfat. Ivanhoe Fancy is from Cole's Fancy of Glenweir, who has a certificate for 514·87 lb. as a mature cow. Cole's Fancy of Glenweir is also by King Cole, so that there is 75 per cent. similar breeding between these two cows. Mr. Weir is to be congratulated upon the success of the breeding plan which has resulted in these two outstanding individuals.

LIST OF RECORDS.

*Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class	Tested by	Age at Start of Test	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS.						
<i>Junior Two-year-old.</i>		Yrs. dys.	lb.		lb.	lb.
Erinview's Treasure ..	John Murray, Woodville ..	2 15	242·0	365	9,474·5	552·37
Koro Koro Buttercup	R. W. Southee, Kiwitea ..	1 363	240·5	365	9,055·7	520·93
Fair's Cherrymaid ..	James Nicolson, Kaupokonui ..	1 318	240·5	365	9,302·5	500·13
Anzac's Heroine ..	H. J. Berry, Kaupokonui ..	2 2	240·7	365	8,391·3	494·98
Ohio Bilberry ..	A. H. Guy, Mangatoki ..	2 50	246·1	365	7,642·2	490·06
Koro Koro Nellie ..	R. W. Southee, Kiwitea ..	2 34	243·9	365	8,443·4	485·27
Koro Koro Pansy ..	R. W. Southee, Kiwitea ..	2 62	246·7	365	8,264·1	470·46
Wairua Frano ..	A. L. Dermer, Stanway ..	1 341	240·5	365	8,499·3	460·09
Raithwaite Superior..	H. H. Buxton, Auroa ..	1 330	240·5	365	8,775·0	452·43
Meadowvale Uniform	F. A. Corney, Egmont Village	2 47	245·2	365	8,958·5	446·47
Raithwaite Briar's Girl	H. H. Buxton, Auroa ..	1 352	240·5	365	7,737·0	405·59
Waipiko Madge ..	F. E. Mills, Stanway ..	2 22	242·7	312	7,876·4	401·62
Tirohanga Lady Gold	E. C. Houchen, Hamilton ..	2 41	244·6	365	7,720·1	382·93
Orielton Sunshine ..	B. Tripp, Gleniti ..	1 358	240·5	365	7,153·7	368·34
Raithwaite Rose ..	H. H. Buxton, Auroa ..	1 250	240·5	329	7,142·3	364·16
Ohio Golden Lenora..	A. H. Guy, Mangatoki ..	2 61	246·6	352	6,746·8	361·67
Niobe ..	C. Parker, Hairini ..	1 340	240·5	342	5,880·6	354·10

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test	Fat req'd for Cert.	Yield for Season.		
				Days	Milk.	Fat.

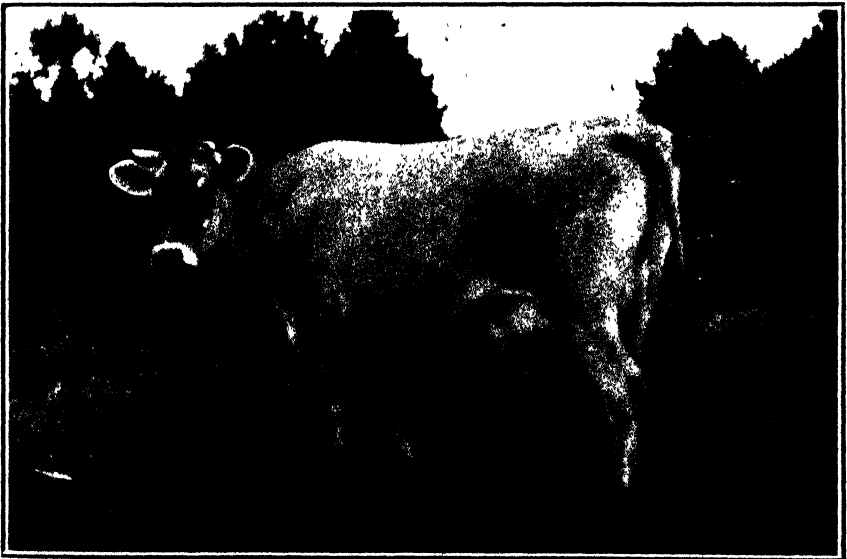
JERSEYS—continued.

<i>Junior Two-year-old—continued.</i>		Yrs	dys	lb.	lb.	lb.	
Anzac's Maid ..	H. J. Berry, Kaupokonui ..	1	312	240.5	365	6,225.2	351.71
Pine Bank Silver Link ..	J. Meuli, Normanby ..	1	261	240.5	365	5,500.1	331.30
Colleen Machree ..	C. Stevens, Maungatapere ..	1	356	240.5	365	6,378.6	321.17
Tinsel's Lady Twylsh ..	Edgar Hofmann, Katikati ..	1	313	240.5	365	5,542.0	319.02
Cruiskeen's Majesty ..	C. Stevens, Maungatapere ..	1	361	240.5	365	5,570.4	317.05
Celebrity's Darling ..	A. Mouldey, Tirau ..	2	61	240.5	358	4,739.9	309.34
Victoria of Bull's ..	W. J. Spooner, Awapuni ..	2	31	243.6	348	6,052.0	306.66
Powhiri ..	O. Monrad, Palmerston N. ..	1	326	240.5	336	5,414.7	306.58
Sunny Meadows Eve ..	F. J. Wyatt, Towai ..	1	334	240.5	355	5,357.5	303.76
Fox's Nobility Pearl ..	W. H. Jakins, Christchurch ..	2	5	241.0	365	5,241.4	290.67
Springbank Dorothea ..	E. S. Holdaway, Ballance ..	1	325	240.5	351	5,357.0	288.59
Springbank Ally's Hope ..	E. S. Holdaway, Ballance ..	1	336	240.5	323	5,907.1	276.19
Springbank Lady ..	E. S. Holdaway, Ballance ..	1	349	240.5	294	5,223.8	262.52
Springbank Kitten ..	E. S. Holdaway, Ballance ..	2	0	240.5	311	5,077.6	259.68
Springbank Jocelyn ..	E. S. Holdaway, Ballance ..	1	347	240.5	305	4,688.4	249.78
<i>Senior Two-year-old</i>							
Genii ..	C. Stevens, Maungatapere ..	2	354	275.9	365	8,159.1	459.71
Beauty's Mignonne ..	D. L. A. Astbury, Mangatoki ..	2	349	275.4	330	6,086.4	436.73
Springbank Re Veale ..	E. S. Holdaway, Ballance ..	2	263	266.8	275	5,146.4	281.92
<i>Three-year-old.</i>							
Marjorie's Twylsh ..	John Murray, Woodville ..	3	342	311.2	365	11,388.5	655.45
August's Cherrybud ..	J. Nicolson, Kaupokonui ..	3	54	282.4	365	10,333.4	634.45
Comely of Rosy Creek ..	L. Wickham, New Plymouth ..	3	20	279.0	358	11,218.5	616.94
Erinview Queen ..	John Murray, Woodville ..	3	19	278.9	365	10,154.0	535.03
Abberly Naomi ..	H. E. B. Watson, Fendalton ..	3	43	281.3	365	10,516.4	531.49
Arietta ..	Dr. H. O. Washbourn, Richmond ..	3	56	282.6	365	10,790.3	510.90
Roslyn Sweetest ..	T. Brownlee, Pukekohe ..	3	90	286.0	365	8,445.9	487.39
Lassie Lucerne ..	W. McGowan, Papatoetoe ..	3	240	301.0	341	8,626.5	428.73
Lakeside Magnet ..	V. W. Nowell, Hawera ..	3	6	277.6	321	6,953.0	425.98
Woodstock's Lertha ..	Banks and Son, Kiwitea ..	3	76	284.6	365	7,137.4	394.62
Woodstock's Zara ..	Banks and Son, Kiwitea ..	3	65	283.5	365	7,748.7	370.02
Springbank Faith ..	E. S. Holdaway, Ballance ..	3	190	296.0	293	5,668.2	299.79
Venus's Delight ..	Edgar Hofmann, Katikati ..	3	12	278.2	338	5,797.4	286.71
Springbank Duchess ..	E. S. Holdaway, Ballance ..	3	50	282.0	323	6,056.3	283.66
<i>Four-year-old.</i>							
Best of All ..	H. H. Buxton, Auroa ..	4	53	318.8	342	10,697.2	582.15
Aster's Rainbow ..	J. Nicolson, Kaupokonui ..	4	78	321.3	395	10,253.4	521.60
Rewa Saint ..	W. H. Booth, Carterton ..	4	35	317.0	365	10,344.2	507.30
Waipiko Leonne ..	C. G. C. Dermer, Waipiko ..	4	46	318.1	365	9,410.1	495.81
You'll do Soumise ..	A. H. Guy, Mangatoki ..	4	6	314.1	365	9,689.2	494.99
Majesty's Orange Fox ..	F. S. Veale, Cambridge ..	4	41	317.6	342	9,058.3	440.07
Rewa Maycan ..	H. E. B. Watson, Fendalton ..	4	11	314.5	261	6,726.6	401.04
Broady's Tinsel ..	Edgar Hofmann, Katikati ..	4	108	324.3	306	5,326.8	327.80
<i>Mature.</i>							
Pretty's Flirt* ..	W. H. Miers, Rukuhia ..	6	353	350.0	365	16,684.1	1010.49
Frances ..	A. L. Dermer, Stanway ..	6	5	350.0	365	11,889.7	735.51
Koro Koro's Silky ..	R. W. Southee, Kiwitea ..	5	346	350.0	365	11,451.3	612.57
Flotsam ..	A. L. Dermer, Stanway ..	9	146	350.0	365	11,962.2	599.74
Waipiko Caress ..	C. G. C. Dermer, Waipiko ..	5	51	350.0	365	9,279.4	567.29
Laurel's Dove ..	John Murray, Woodville ..	5	25	350.0	360	10,211.0	550.62



ALFALFA PANSY (F. J. SAXBY, OHAUPO).

Leader of the Jersey junior two-year-old class. C.O.R. 1923. 10,898.1 lb. milk, 690.16 lb. butterfat.



ZOLA OF ROSY CREEK (E. JOYCE, KAPONGA).

Leader of the Jersey three-year-old class. C.O.R. 1923: 12,478.6 lb. milk, 741.2 lb. butterfat.

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS—*continued.*

<i>Mature</i> — <i>continued.</i>		Yrs.	dys	lb.		lb.	lb.
Ethel's Creamy Lass	L. K. Tarrant, Ngaere	7	55	350.0	292	9,248.6	536.18
Oakvale's Grace	A. H. Guy, Mangatoki	6	96	350.0	365	8,940.2	516.05
Golden Fern	C. Stevens, Maungatapere	9	109	350.0	365	10,150.6	489.49
Olga's Darling	A. Mouldey, Tirau	8	38	350.0	355	8,974.8	486.24
Waratah Tinsel	E. Hofmann, Katikati	6	24	350.0	365	8,924.9	484.11
Laurel's Bright Hope	John Murray, Woodville	7	44	350.0	365	7,923.5	480.61
Pretty Lass	John Hale, New Plymouth	6	7	350.0	365	8,351.4	472.21
Cowslip 9th	W. T. Williams, Pukehou	9	120	350.0	365	9,557.5	469.49
Lady Joffre	E. L. Roose, Pukekohe	7	326	350.0	364	9,946.2	439.45
Middlewood's Queen	Banks and Son, Kiwitea	6	104	350.0	365	6,763.9	394.72
Victoria's Success	B. Tripp, Gleniti	9	339	350.0	298	7,032.3	387.72
Lady Swan	A. Best, Bombay	11	83	350.0	365	8,350.0	374.52

FRIESIANS.

<i>Junior Two-year-old.</i>							
Bainfield Topsy 13th*	W. D. Hunt, Waikiwi	2	34	243.9	365	15,061.0	641.88
Bainfield Pansy 3rd*	W. D. Hunt, Waikiwi	2	174	257.9	365	14,708.8	609.34
Dominion Queen Olga	Central Development Farm, Weraroa	2	57	246.2	365	12,985.7	460.12
Tokaora Beets Sunshine†	H. E. Johnson, Tokaora	2	35	244.0	365	10,455.7	458.47
Oaklea Creamelle*	R. A. Wilson, Turakina	2	82	248.7	365	14,033.1	439.94
Tokaora Netherland Rose†	H. E. Johnson, Tokaora	2	77	248.2	327	12,358.2	436.26
Tokaora Manor Beets*	H. E. Johnson, Tokaora	2	80	248.5	336	11,591.7	413.57
Countess Ena Hero†	N. P. Nielsen, Tiakitahuna	2	53	245.8	365	12,090.6	411.01
Oaklea Mercena Lassie†	R. A. Wilson, Turakina	2	22	242.7	292	8,866.7	374.53
Ashlynn 118th	J. H. Jamieson, Fencourt	2	4	240.9	365	9,036.4	364.71
Oaklea Pauline de Kol†	Knight and Sons, Ongarue	2	96	250.1	336	9,964.3	360.87
Lady Van Cleve Gem†	N. P. Nielsen, Tiakitahuna	1	295	240.5	364	10,575.1	343.07
Mahoe Nancy Leaf	R. A. Wilson, Turakina	1	251	240.5	322	10,057.5	333.75
Dominion Spot 6th	Central Development Farm, Weraroa	2	66	247.1	343	8,315.8	330.38
Tunanui Domino Mechthild†	R. A. Wilson, Turakina	1	309	240.5	318	9,333.1	325.52
Oaklea Minto Millbrook†	Knight and Sons, Ongarue	2	54	245.9	285	8,277.6	288.48
Penrest Daisy of Fencourt	J. H. Jamieson, Cambridge	2	18	242.3	360	8,497.4	253.83
<i>Senior Two-year-old.</i>							
Knight Pauline Alcartra†	S. Andrew, Kaikoura	2	217	262.2	365	13,769.6	439.94
<i>Junior Three-year-old.</i>							
Monarch Queen Jessie	W. D. Hunt, Waikiwi	3	51	282.1	365	14,728.6	578.08
Duchess Abbekerk 2nd†	Voss Bros., Longburn	3	107	287.7	355	10,010.3	368.24
<i>Senior Three-year-old.</i>							
Pauline de Kol Fayne*	R. A. Wilson, Turakina	3	245	301.5	365	15,523.3	598.48
Dominion Miss Mierlo	Central Development Farm, Weraroa	3	352	312.2	314	17,106.5	579.69
<i>Junior Four-year-old.</i>							
Friesland Model Maid*	A. S. Elworthy, Timaru	4	152	328.7	365	13,668.5	394.76

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert	Yield for Season.		
				Days	Milk.	Fat.
FRIESIANS— <i>continued.</i>						
<i>Senior Four-year-old.</i>		Yrs. dys	lb.		lb.	lb.
Monavale Dairymaid Paxton*	W. D. Hunt, Waikiwi ..	4 361	349·6	365	20,146·3	712·10
Longbeach Transvaal Princess*	J. H. Grigg, Longbeach ..	4 304	343·9	364	21,126·0	584·76
<i>Mature.</i>						
Rosevale Stella* ..	North and Sons, Omumi ..	6 63	350·0	365	22,002·7	743·17
Eilcen Girl* ..	A. W. Chapman, Gordonton ..	8 23	350·0	365	21,085·5	704·93
Clothilde Alcartri Fayne*	A. W. Chapman, Gordonton ..	7 10	350·0	365	20,566·3	654·57
Pauline Acme 3rd* ..	G. F. Court, Panmure ..	10 271	350·0	365	21,593·2	633·58
Time Grant 3rd* ..	G. F. Court, Panmure ..	7 6	350·0	365	19,640·9	632·04
Jules Colantha of Friesian Holm*	John Stables, Riverlea ..	9 4	350·0	326	12,716·7	524·61
Monavale Evergreen Paxton†	S. Clements, Rototuna ..	6 85	350·0	302	13,293·8	506·52
AYRSHIRES.						
<i>Three-year-old.</i>						
Zandie of Waipapa ..	Fred. Mills, Waipapa	3 311	301·1	365	10,316·5	419·01
<i>Four-year-old.</i>						
Ivanhoe Fancy† ..	A. M. Weir, Menzies Ferry ..	4 308	344·3	365	14,207·7	713·93
<i>Mature.</i>						
Ivanhoe Fillpail* ..	A. M. Weir, Menzies Ferry ..	..	350·0	365	16,362·7	646·31



DIMPLE OF EDENDALE (W. HALL, LEPPERTON).

Leader of the Ayrshire two-year-old class, C.O.R. 1923: 13,063·3 lb. milk, 529·46 lb. butterfat.

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test	Fat req'd for Cert	Yield for Season.		
				Days	Milk.	Fat.
MILKING SHORTHORNS.						
<i>Junior Two-year-old.</i> Pine Farm Harriet 1st	James Parkinson, Opotiki ..	2 6	241.1	365	15,273.3	552.85
<i>Senior Two-year-old.</i> Dilworth Eclipse ..	J. W. Robinson, Runciman	2 339	274.4	345	7,777.3	311.95
<i>Junior Four-year-old.</i> Hukerewai Rona ..	J. W. Robinson, Runciman	4 19	315.4	365	10,192.4	379.99
<i>Mature.</i> Ardwell Dolly ..	J. W. Robinson, Runciman	..	350	295	10,306.0	376.34

Second-class Certificates.

JERSEYS.

<i>Three-year-old.</i> Rewa Arabis ..	G. B. Hull, Silverstream ..	3 28	279.8	365	9,255.3	475.45
<i>Mature.</i> Caprice ..	A. L. Dermer, Stanway ..	6 243	350.0	365	8,403.1	506.93

FRIESIANS.

<i>Senior Two-year-old.</i> Rai Alcartra* ..	S. Andrew, Kaikoura ..	2 289	269.4	365	14,076.2	455.07
Parcora Transvaal Fancy*	A. S. Elworthy, Timaru ..	2 314	271.9	365	11,744.5	450.42

MILKING SHORTHORNS.

<i>Mature.</i> Hoeka Mary ..	Ranstead Bros., Matangi ..	..	350.0	365	13,678.9	498.51
Matangi Geraldine ..	Ranstead Bros., Matangi ..	..	350.0	365	11,471.0	437.96

Seed Research Work carried out at the Biological Laboratory, Wellington, is summarized as follows in the annual report of the Department of Agriculture for 1922-23: Research work upon the cause of and overcoming the loss of vitality in Chewings fescue seed during and after overseas shipment is still being continued. With the data attained from experiments carried out in co-operation with the United States Department of Agriculture, together with that from a series of experiments now being commenced, it is hoped that the New Zealand Department will very soon be in a position to advise merchants, so that they may ship Chewings fescue with confidence. Various other researches in matters relating to seed work generally have been carried out as follows: Increasing germination of rye-grass by drying process; storage of Chewings fescue under cool storage and subsequently higher temperatures; improved methods of testing peas and beans; co-operation with English seed firms in research into the loss of vitality of seeds during import and export; standardization of source-indicators of agricultural seeds (in co-operation with the Seed Control Station, Zurich, Switzerland); standardization of methods of seed-analysis (in co-operation with the Royal Seed Control Station, Copenhagen, Denmark); statistical study of seed impurities and germination behaviour of New-Zealand-grown agricultural seeds.

RABBIT-POISONING WITH PHOSPHORIZED POLLARD AND GRAIN.

Live-stock Division.

PHOSPHORIZED POLLARD.

Recipe No. 1.—Boil 3 quarts of water and $4\frac{1}{2}$ lb. of brown sugar in a clean oil-drum or kerosene-tin. When the liquor is boiling take it off the fire and put in two sticks of phosphorus (about 4 oz.). After allowing a minute or so for the phosphorus to thoroughly dissolve, boil the whole again. Then lift it off the fire, and immediately begin stirring-in pollard. Stir hard, as this is the time to get the phosphorus well distributed. Continue adding pollard until the mass becomes sufficiently stiff for kneading.

For large quantities the proportions required are as follows: 18 lb. sugar, 1 lb. phosphorus, 3 gallons water, with sufficient pollard (about 60 lb.) to make a stiff dough.

Recipe No. 2.—Mix, in a pickle-bottle or a tin with a tight-fitting lid, 1 tablespoonful of bisulphide of carbon and $1\frac{1}{2}$ sticks of phosphorus with $\frac{1}{2}$ pint of cold water. Allow this to stand till the phosphorus is thoroughly dissolved. In $3\frac{1}{2}$ pints of hot water dissolve 3 lb. of sugar. Pour both these liquors into a clean vessel and stir well; then add pollard until the dough becomes stiff enough for kneading.

For large quantities the proportions required are as follows: 4 tablespoonfuls (2 oz.) bisulphide of carbon, 16 lb. to 18 lb. sugar, 1 lb. phosphorus, 11 quarts water, and sufficient pollard (about 60 lb.) to make the dough stiff enough for kneading and dividing into cubes.

With either recipe if the weather is extremely dry it is better to use one-third less sugar, and substitute an equal weight of treacle. This will prevent undue hardening.

Preparing the Baits.—Use a clean board and roller, and keep them well dusted with dry pollard. Take a quantity of the dough out of the vessel with a spade or flat stick, throw dry pollard on it to stop any sparking, knead it, and roll it out to $\frac{1}{4}$ in. thickness. Then cut it into $\frac{1}{2}$ in. squares, and throw the ragged edges back into the vessel. Gather up the squares and place them in a shallow box or tray, sprinkle over with some dry pollard, and allow them to dry out before tinning up or using.

When making large quantities, by hand, the cutting is generally done with a disc-roller cutter. A poison-mixing machine is also on the market, which does the whole of the mixing and cutting into cubes. This machine is suitable when large quantities of poison are being manufactured.

Laying the Poison.—One way of laying the poison is by turning a sod with a spade or adze, and placing one or two squares on top of it. Some prefer placing the baits in the holes made by the spade or adze. Another way is to lay them at intervals in a plough-furrow. The number of baits laid must be according to the state of the rabbit pest.

On bare run-country the poison may be laid without using spade, adze, or plough, the baits being dropped on the barer patches of ground. This method has proved satisfactory in many cases, but more poisoned baits require to be laid than with the other methods, as there is no freshly turned earth to attract the rabbit to the baits.

PHOSPHORIZED GRAIN.

Recipe and Preparation.—Take 120 lb. of grain, 18 sticks (2 lb. 4 oz.) of phosphorus, and $4\frac{1}{2}$ to 5 gallons of water; 9 lb. of sugar is also added in most cases, but the poison is said by some users to be equally well taken without this. The water is boiled in an iron cylinder, which is fitted with a spindle and set up on iron posts or frame, a fire being lighted beneath it. When the water is boiling the phosphorus is put in and stirred until every particle is thoroughly dissolved, after which the grain is poured in and the lid screwed on tightly. The cylinder is then turned slowly and steadily for twenty minutes or more (the fire being put out after about ten minutes turning), again turned for a few minutes every half-hour for an hour or two, and then given a few turns several times during the remainder of the day. The poison should be left in the drum for at least twenty-four hours if possible, and preferably a little longer. If taken out too soon the fumes are very strong and dense and unhealthy to work in, and it takes twenty-four hours to thoroughly impregnate the grain with the phosphorus.

Where no iron cylinder is available the grain can be boiled in clean drums or petrol-tins for ten minutes, and then put into a barrel with spindle and turning-handle affixed and set on a frame or posts. This barrel must be provided with a manhole on its side, which must be fitted with an airtight lid to prevent leakage of fumes. The barrel should be rotated at intervals in the manner explained above, and left for at least twenty-four hours before removal of the poisoned grain.

Some makers prefer to soak the grain (especially if barley is used) for twenty-four hours in cold water before boiling, in which case less than the above-stated quantity of water will be required for boiling it. In connection with the sugar constituent, some prefer not to boil this with the grain, but to mix it with the poisoned grain on the day of laying.

If kept in an airtight container the poisoned grain will remain good for some time.

Laying the Poison.—Lay the rows about a chain apart, and deposit on barest parts of the ground about a dozen grains every few yards. In many cases it will be found advisable to lay the grain on freshly turned sods or in plough-furrows.

GENERAL POINTS.

Stock should be removed before laying the poison.

Phosphorus should always be kept in water, and, for greater safety, away from buildings. Bisulphide of carbon should be securely corked, and stored in a cool place, as the fumes are dangerous if inhaled.

A READY-RECKONER FOR WEIGHT OF FIELD CROPS PER ACRE.

(Continued.)

TABLE SHOWING WEIGHT OF CROP PER ACRE WHEN THE AREA FROM WHICH THE PRODUCE IS TAKEN IS 1 CHAIN IN 24 IN. DRILLS—EQUIVALENT TO $\frac{1}{380}$ ACRE.

Weight per Acre	Weight per Acre	Weight per Acre	Weight per Acre	Weight per Acre	Weight per Acre	Weight per Acre
Tons cwt qr lb	Tons cwt qr lb	Tons cwt qr lb	Tons cwt qr lb	Tons cwt qr lb	Tons cwt qr lb	Tons cwt qr lb
1 0 2 3	22 61	8 19 2 26	121 17 16 2 2	181 26 13 1 6		
2 0 5 3	16 62	9 2 2 20	122 17 19 1 24	182 26 10 1 0		
3 0 8 3	10 63	9 5 2 14	123 18 2 1 18	183 26 19 0 22		
4 0 11 3	4 04	9 8 2 8	124 18 5 1 12	184 27 2 0 16		
5 0 14 2	26 05	9 11 2 2	125 18 8 1 0	185 27 5 0 10		
6 0 17 2	20 66	9 14 1 24	126 18 11 1 0	186 27 8 0 4		
7 1 0 2	11 67	9 17 1 18	127 18 14 0 22	187 27 10 3 26		
8 1 3 2	8 68	10 0 1 12	128 18 17 0 16	188 27 13 3 20		
9 1 6 2	2 69	10 3 1 6	129 19 0 0 10	189 27 16 3 14		
10 1 9 2	24 70	10 6 1 0	130 19 3 0 4	190 27 19 3 8		
11 1 12 1	18 71	10 9 0 22	131 19 5 3 26	191 28 2 3 2		
12 1 15 1	12 72	10 12 0 16	132 19 8 3 20	192 28 5 2 24		
13 1 18 1	6 73	10 15 0 10	133 19 11 3 14	193 28 8 2 18		
14 2 1 1	0 74	10 18 0 4	134 19 14 3 8	194 28 11 2 12		
15 2 4 0	22 75	11 0 3 26	135 19 17 3 2	195 28 14 2 6		
16 2 7 0	16 76	11 3 3 20	136 20 0 2 24	196 28 17 2 0		
17 2 10 0	10 77	11 6 3 14	137 20 3 2 18	197 29 0 1 22		
18 2 13 0	4 78	11 9 3 8	138 20 6 2 12	198 29 3 1 16		
19 2 15 3	26 79	11 12 3 2	139 20 9 2 6	199 29 6 1 0		
20 2 18 3	20 80	11 15 2 24	140 20 12 2 0	200 29 9 1 4		
21 3 1 3	14 81	11 18 2 18	141 20 15 1 22	201 29 12 0 26		
22 3 1 1	8 82	12 1 2 12	142 20 18 1 6	202 29 15 0 20		
23 3 7 3	2 83	12 4 2 6	143 21 1 1 0	203 29 18 0 14		
24 3 10 2	24 84	12 7 2 0	144 21 4 1 4	204 30 1 0 8		
25 3 13 2	18 85	12 10 1 22	145 21 7 0 26	205 30 4 0 2		
26 3 16 2	12 86	12 13 1 16	146 21 10 0 20	206 30 6 3 24		
27 3 19 2	6 87	12 16 1 10	147 21 13 0 14	207 30 9 3 18		
28 4 2 2	0 88	12 19 1 4	148 21 16 0 8	208 30 12 3 12		
29 4 5 1	22 89	13 0 2 26	149 21 19 0 2	209 30 15 3 6		
30 4 8 1	16 90	13 3 0 20	150 22 1 3 24	210 30 18 3 0		
31 4 11 1	10 91	13 6 0 14	151 22 4 3 18	211 31 1 2 22		
32 4 14 1	4 92	13 9 0 8	152 22 7 3 12	212 31 4 2 16		
33 4 17 0	26 93	13 14 0 2	153 22 10 3 6	213 31 7 2 10		
34 5 0 0	20 94	13 16 3 24	154 22 13 3 0	214 31 10 2 4		
35 5 3 0	14 95	13 19 3 18	155 22 16 2 22	215 31 13 1 26		
36 5 6 0	8 96	14 2 3 12	156 22 19 2 16	216 31 16 1 20		
37 5 9 0	2 97	14 5 3 6	157 23 2 2 10	217 31 19 1 14		
38 5 11 3	24 98	14 8 3 0	158 23 5 2 4	218 32 2 1 8		
39 5 14 3	18 99	14 11 2 22	159 23 8 1 26	219 32 5 1 12		
40 5 17 3	12 100	14 14 2 16	160 23 11 1 20	220 32 8 0 24		
41 6 0 3	6 101	14 17 2 10	161 23 14 1 14	221 32 11 0 18		
42 6 3 3	0 102	15 0 2 4	162 23 17 1 8	222 32 14 0 12		
43 6 6 2	22 103	15 3 1 26	163 24 0 1 2	223 32 17 0 6		
44 6 9 2	16 104	15 6 1 20	164 24 3 0 24	224 33 0 0 0		
45 6 12 2	10 105	15 9 1 14	165 24 6 0 18	225 33 3 2 22		
46 6 15 2	4 106	15 12 1 8	166 24 9 0 12	226 33 5 3 16		
47 6 18 1	26 107	15 15 1 2	167 24 12 0 6	227 33 8 3 10		
48 7 1 1	20 108	15 18 0 24	168 24 15 0 0	228 33 11 3 4		
49 7 4 1	14 109	16 1 0 18	169 24 17 3 22	229 33 14 2 26		
50 7 7 1	8 110	16 4 0 12	170 25 0 3 16	230 33 17 2 20		
51 7 10 1	2 111	16 7 0 6	171 25 3 3 10	231 34 0 2 14		
52 7 13 0	24 112	16 10 0 0	172 25 6 3 4	232 34 3 2 8		
53 7 16 0	18 113	16 12 3 22	173 25 9 2 26	233 34 6 2 2		
54 7 19 0	12 114	16 15 3 16	174 25 12 2 20	234 34 9 1 24		
55 8 2 0	6 115	16 18 3 10	175 25 15 2 14	235 34 12 1 18		
56 8 5 0	0 116	17 1 3 4	176 25 18 2 8	236 34 15 1 12		
57 8 7 3	22 117	17 4 2 26	177 26 1 2 2	237 34 18 1 6		
58 8 10 3	16 118	17 7 2 20	178 26 4 1 24	238 35 1 1 0		
59 8 13 3	10 119	17 10 2 14	179 26 7 1 18	239 35 4 0 22		
60 8 16 3	4 120	17 13 2 8	180 26 10 1 12	240 35 7 0 16		

TABLE SHOWING WEIGHT OF CROP PER ACRE—continued.

Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.
lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.
241	35 10 0 10	319	46 19 3 18	397	58 9 2 26	475	69 19 2 6
242	35 13 0 4	320	47 2 3 12	398	58 12 2 20	476	70 2 2 0
243	35 15 3 26	321	47 5 3 6	399	58 15 2 14	477	70 5 1 22
244	35 18 3 20	322	47 8 3 0	400	58 18 2 8	478	70 8 1 16
245	36 1 3 14	323	47 11 2 22	401	59 1 2 2	479	70 11 1 10
246	36 4 3 8	324	47 14 2 16	402	59 4 1 24	480	70 14 1 4
247	36 7 3 2	325	47 17 2 10	403	59 7 1 18	481	70 17 0 26
248	36 10 2 24	326	48 0 2 4	404	59 10 1 12	482	71 0 0 20
249	36 13 2 18	327	48 3 1 26	405	59 13 1 6	483	71 3 0 14
250	36 16 2 12	328	48 6 1 20	406	59 16 1 0	484	71 6 0 8
251	36 19 2 6	329	48 9 1 14	407	59 19 0 22	485	71 9 0 2
252	37 2 2 0	330	48 12 1 8	408	60 2 0 16	486	71 11 3 24
253	37 5 1 22	331	48 15 1 2	409	60 5 0 10	487	71 14 3 18
254	37 8 1 16	332	48 18 0 24	410	60 8 0 4	488	71 17 3 12
255	37 11 1 10	333	49 1 0 18	411	60 10 3 26	489	72 0 3 6
256	37 14 1 4	334	49 4 0 12	412	60 13 3 20	490	72 3 3 0
257	37 17 0 26	335	49 7 0 6	413	60 16 3 14	491	72 6 2 22
258	38 0 0 20	336	49 10 0 0	414	60 19 3 8	492	72 9 2 16
259	38 3 0 14	337	49 12 3 22	415	61 2 3 2	493	72 12 2 10
260	38 6 0 8	338	49 15 3 16	416	61 5 2 24	494	72 15 2 4
261	38 9 0 2	339	49 18 3 10	417	61 8 2 18	495	72 18 1 26
262	38 11 3 24	340	50 1 3 4	418	61 11 2 12	496	73 1 1 20
263	38 14 3 18	341	50 4 2 26	419	61 14 2 6	497	73 4 1 14
264	38 17 3 12	342	50 7 2 20	420	61 17 2 0	498	73 7 1 8
265	39 0 3 6	343	50 10 2 14	421	62 0 1 22	499	73 10 1 2
266	39 3 3 0	344	50 13 2 8	422	62 3 1 16	500	73 13 0 24
267	39 6 2 22	345	50 16 2 2	423	62 6 1 10	501	73 16 0 18
268	39 9 2 16	346	50 19 1 24	424	62 9 1 4	502	73 19 0 12
269	39 12 2 10	347	51 2 1 18	425	62 12 0 26	503	74 2 0 6
270	39 15 2 4	348	51 5 1 12	426	62 15 0 20	504	74 5 0 0
271	39 18 1 26	349	51 8 1 6	427	62 18 0 14	505	74 7 3 22
272	40 1 1 20	350	51 11 1 0	428	63 1 0 8	506	74 10 3 16
273	40 4 1 14	351	51 14 0 22	429	63 4 0 2	507	74 13 3 10
274	40 7 1 8	352	51 17 0 16	430	63 7 3 24	508	74 16 3 4
275	40 10 1 2	353	52 0 0 10	431	63 9 3 18	509	74 19 2 26
276	40 13 0 24	354	52 3 0 4	432	63 12 3 12	510	75 2 2 20
277	40 16 0 18	355	52 5 3 26	433	63 15 3 6	511	75 5 2 14
278	40 19 0 12	356	52 8 3 20	434	63 18 3 0	512	75 8 2 8
279	41 2 0 6	357	52 11 3 14	435	64 1 2 22	513	75 11 2 2
280	41 5 0 0	358	52 14 3 8	436	64 4 2 16	514	75 14 2 24
281	41 7 3 22	359	52 17 3 2	437	64 7 2 10	515	75 17 1 18
282	41 10 3 16	360	53 0 2 24	438	64 10 2 4	516	76 0 1 12
283	41 13 3 10	361	53 3 2 18	439	64 13 1 26	517	76 3 6 1
284	41 16 3 4	362	53 6 2 12	440	64 16 1 20	518	76 6 1 0
285	41 19 2 26	363	53 9 2 6	441	64 19 1 14	519	76 9 0 22
286	42 2 2 20	364	53 12 2 0	442	65 2 1 8	520	76 12 0 16
287	42 5 2 14	365	53 15 1 22	443	65 5 1 2	521	76 15 0 10
288	42 8 2 8	366	53 18 1 6	444	65 8 0 24	522	76 18 0 4
289	42 11 2 2	367	54 1 1 0	445	65 11 0 18	523	77 0 3 26
290	42 14 1 24	368	54 4 1 4	446	65 14 0 12	524	77 3 3 20
291	42 17 1 18	369	54 7 0 26	447	65 17 0 6	525	77 6 3 14
292	43 0 1 12	370	54 10 0 20	448	66 0 0 0	526	77 9 3 8
293	43 3 1 6	371	54 13 0 14	449	66 2 3 22	527	77 12 3 2
294	43 6 1 0	372	54 16 0 8	450	66 5 3 16	528	77 15 2 24
295	43 9 0 22	373	54 19 0 2	451	66 8 3 10	529	77 18 2 18
296	43 12 0 16	374	55 1 3 24	452	66 11 3 4	530	78 1 2 12
297	43 15 0 10	375	55 4 3 18	453	66 14 2 26	531	78 4 2 6
298	43 18 0 4	376	55 7 3 12	454	66 17 2 20	532	78 7 2 0
299	44 0 3 26	377	55 10 3 6	455	67 0 2 14	533	78 10 1 22
300	44 3 3 20	378	55 13 3 0	456	67 3 2 8	534	78 13 1 16
301	44 6 3 14	379	55 16 2 22	457	67 6 2 2	535	78 16 1 10
302	44 9 3 8	380	55 19 2 16	458	67 9 1 24	536	78 19 1 4
303	44 12 3 2	381	56 2 2 10	459	67 12 1 18	537	79 2 0 26
304	44 15 2 24	382	56 5 2 4	460	67 15 1 12	538	79 5 0 20
305	44 18 2 18	383	56 8 1 26	461	67 18 1 6	539	79 8 0 14
306	45 1 2 12	384	56 11 1 20	462	68 1 1 0	540	79 11 0 8
307	45 4 2 6	385	56 14 1 14	463	68 4 0 22	541	79 14 0 2
308	45 7 2 0	386	56 17 1 8	464	68 7 0 16	542	79 16 3 24
309	45 10 1 22	387	57 0 1 2	465	68 10 0 10	543	79 19 3 18
310	45 13 1 16	388	57 3 0 24	466	68 13 0 4	544	80 2 3 12
311	45 16 1 10	389	57 6 0 18	467	68 16 3 26	545	80 5 3 6
312	45 19 1 4	390	57 9 0 12	468	68 19 3 20	546	80 8 3 0
313	46 2 0 26	391	57 12 0 6	469	69 1 3 14	547	80 11 2 22
314	46 5 0 20	392	57 15 0 0	470	69 4 3 8	548	80 14 2 16
315	46 8 0 14	393	57 17 3 22	471	69 7 3 2	549	80 17 2 10
316	46 11 0 8	394	58 0 3 16	472	69 10 2 24	550	81 0 2 4
317	46 14 0 2	395	58 3 3 10	473	69 13 2 18	551	81 3 1 16
318	46 16 3 24	396	58 6 3 4	474	69 16 2 12	552	81 6 1 20

TABLE SHOWING WEIGHT OF CROP PER ACRE—*continued.*

Weight per Area.	Weight per Acre		Weight per Area	Weight per Acre.		Weight per Area	Weight per Acre		Weight per Area	Weight per Acre.	
lb.	Tons	cwt. qr lb.	lb.	Tons	cwt. qr lb.	lb.	Tons	cwt. qr lb.	lb.	Tons	cwt. qr lb.
553	81	9 1 14	585	86	3 2 18	617	90	17 3 22	649	95	12 0 26
554	81	12 1 8	586	86	6 2 12	618	91	0 3 16	650	95	15 0 20
555	81	15 1 2	587	86	9 2 6	619	91	3 3 10	651	95	18 0 14
556	81	18 0 24	588	86	12 2 0	620	91	6 3 4	652	96	1 0 8
557	82	1 0 18	589	86	15 1 22	621	91	9 2 26	653	96	4 0 2
558	82	4 0 12	590	86	18 1 6	622	91	12 2 20	654	96	6 3 24
559	82	7 0 6	591	87	1 1 0	623	91	15 2 14	655	96	9 3 18
560	82	10 0 0	592	87	4 1 4	624	91	18 2 8	656	96	12 3 12
561	82	12 3 22	593	87	7 0 26	625	92	1 2 2	657	96	15 3 6
562	82	15 3 16	594	87	10 0 20	626	92	4 1 24	658	96	18 3 0
563	82	18 3 10	595	87	13 0 14	627	92	7 1 18	659	97	1 2 22
564	83	1 3 4	596	87	16 0 8	628	92	10 1 12	660	97	4 2 16
565	83	4 2 26	597	87	19 0 2	629	92	13 1 6	661	97	7 2 10
566	83	7 2 20	598	88	1 3 24	630	92	16 1 0	662	97	10 2 4
567	83	10 2 14	599	88	4 3 18	631	92	19 0 22	663	97	13 1 26
568	83	13 2 8	600	88	7 3 12	632	93	2 0 16	664	97	16 1 20
569	83	16 2 2	601	88	10 3 6	633	93	5 0 10	665	97	19 1 14
570	83	19 1 24	602	88	13 3 0	634	93	8 0 4	666	98	2 1 8
571	84	2 1 18	603	88	16 2 22	635	93	10 3 26	667	98	5 1 2
572	84	5 2 12	604	88	19 2 16	636	93	13 3 20	668	98	8 0 24
573	84	8 1 6	605	89	2 2 10	637	93	16 3 14	669	98	11 0 18
574	84	11 1 0	606	89	5 2 4	638	93	19 3 8	670	98	14 0 12
575	84	14 0 22	607	89	8 1 26	639	94	2 3 2	671	98	17 0 6
576	84	17 0 16	608	89	11 1 20	640	94	5 2 24	672	99	0 0 0
577	85	0 0 10	609	89	14 1 14	641	94	8 2 18	673	99	2 3 22
578	85	3 0 4	610	89	17 1 8	642	94	11 2 12	674	99	5 3 16
579	85	5 3 26	611	90	0 1 2	643	94	14 2 6	675	99	8 3 10
580	85	8 3 20	612	90	3 0 24	644	94	17 2 0	676	99	11 3 4
581	85	11 3 14	613	90	6 0 18	645	95	0 1 22	677	99	14 2 26
582	85	14 3 8	614	90	9 0 12	646	95	3 1 6	678	99	17 2 20
583	85	17 3 2	615	90	12 0 6	647	95	6 1 0	679	100	0 2 14
584	86	0 2 24	616	90	15 0 0	648	95	9 1 4			

—C. H. Schwass. *Fields Division, Wellington.**(To be continued.)***RESTRICTIONS ON IMPORTATION OF LIVE-STOCK.**

From Australia.—On account of the outbreak of rinderpest in Western Australia, and to guard against the danger of its introduction into New Zealand, the importation of sheep, swine, or fodder from New South Wales, Victoria, or South Australia was, by an amendment to the Regulations under the Stock Act gazetted last month, prohibited, except with the precedent consent of the Minister of Agriculture. All stock are already prohibited entry into New Zealand from the States of Queensland and Western Australia, and as cattle have been absolutely prohibited from the other States of the Commonwealth, except Tasmania, for some years past, the effect of the amendment is to make it unlawful for any classes of stock mentioned in it to be introduced from the States of New South Wales, Victoria, and South Australia without previous permission, an embargo being on the other States and the absolute prohibition remaining on cattle from all States.

From the United Kingdom.—On account of continued outbreaks of foot-and-mouth disease in Britain a regulation under the Stock Act was also gazetted last month prohibiting the introduction of cattle, sheep, and swine, and fodder for live-stock, from the United Kingdom. This regulation does not apply to live-stock shipped before the date of its coming into operation—namely, 10th January, 1924.

Rabbit-poisoning with Strychnine.—In the article on this subject published in last month's *Journal* (page 32) the headline "Strychnine and Sugar Paste" was inadvertently misplaced. It should have headed the succeeding paragraph commencing with the words "The mode of preparing the poison"

SEASONAL NOTES.

THE FARM.

CULTURAL WORK.

THE exceptionally early completion of harvesting operations this season affords an excellent opportunity for the preparation of the soil for early autumn-sown crops, and, since good cultivation is the first essential in crop-production, one may look forward to crops getting at least a good seed-bed if full advantage is taken of the occasion.

The importance of preparatory skim-ploughing can hardly be too highly stressed. Skimming, followed by breaking-down, enables the establishment of a good tilth to the full depth of the subsequent deep ploughing. Many farmers are inclined to view the extra ploughing as being not worth while, but if it is remembered that the difference between a good tilth and a bad one may mean a difference of, say, several bushels in grain yield, it can be easily realized that any additional work is justified and pays for itself handsomely. Again, it is easier to cultivate lightly ploughed land than that which is deeply ploughed, and the minimum of work is necessary in breaking-down the deep ploughing which follows well-cultivated skimming. If the ground is inclined to be twitchy a single deep ploughing and subsequent cultivation will not suffice to provide the desirable uniform tilth. So much work is required in the attempt to compact the soil and provide a continuity of soil-particles from below upward that even though the surface is worked down to a very fine state air-spaces will still occur below—a most undesirable condition. In dirty or stiff lands practically no implement can work satisfactorily to the full depth of the deep furrow. It is therefore good practice to skim and work on the skimming at intervals until the ground is required for deep ploughing preparatory to sowing crops.

Where a winter fallow is intended ploughing should be done at a fair depth on the heavier soils. In order that a rough surface may be exposed to the ameliorating effect of winter weather the plough should be set so that the furrow slice is turned as much as possible on edge.

GREEN CROPS.

The sowing of green crops as suggested in last month's notes should be pushed forward. March is usually a good month in which to sow oats and tares or similar crops for early spring feeding—letting them run on later for ensilage or hay crops. For average conditions Algerian oats, 2 bushels, and winter tares, 1 bushel, or wheat, 2 bushels, and tares, 1 bushel, are suitable mixtures. Basic super, or mixtures of half super and half Nauru phosphate or basic slag, 1 cwt. to 2 cwt. per acre, are suitable manures. Peas are at times used instead of tares, but they do not stand the feeding and the winter well. All land that has grown soft turnips or other forages and is not to be put down in pasture should be sown in one or other of these catch-crops, so as to keep the land clean and provide early feed.

In the North late February and March are favourite months for sowing turnips, whether they are being grown on new ground that has been fallowed during the summer or in succession to millet or oats. Red Paragon or Devonshire Greystone mature quickly for early feeding, and Green-top are good late turnips. Swedes are good keepers, but are a bit chancy if sown after the end of February. In addition to roots, spring feed may be provided by sowing a quick-growing mixture of Italian rye-grass, Western Wolths rye-grass, and red clover or crimson clover, according to local conditions. Oats, either with or without rye-grass, are favoured in some districts.

For South Otago and Southland conditions, a mixture of Western Wolths rye-grass, 30 lb., and red clover, 4 lb., will provide early feed, and should suit those farmers who intend using the same area for late sowings of turnips next season. A mixture of Dun oats, 2½ bushels, and tares, 1½ bushels, also makes good early feed. Where economic reasons demand the autumn-sowing of grass along with the crop then tares should be omitted, the oats and grass being sown in conjunction. Another crop well worthy of trial is Cape barley.

In Canterbury and North Otago Italian rye-grass or Western Wolths may be sown with advantage in March, and with favourable weather a good growth of very early spring feed should be assured—in fact, on good land there is every likelihood of late autumn grazing. A seeding of 30 lb. per acre is generally sufficient, and if from ½ lb. to 1 lb. of rape is sown with the rye-grass, a certain amount of autumn feed is practically certain.

AUTUMN-SOWING OF PASTURES.

The subject of autumn grassing was dealt with in last month's notes, and this work should be pushed along in March so as to give the young plants, particularly clovers, time to establish before cold weather sets in. When land is being prepared for permanent pasture great care should be taken to see that the soil is in a good state of fertility and that a good seed-bed is prepared. If the land has been cropped out it is much the wisest plan to put it in a temporary pasture and allow it to build up for a year or two before sowing the expensive permanent mixture. Having decided to put in a permanent pasture, the next thing is to select a good mixture and obtain first-class seed. In selecting the mixture the farmer must be guided by his soil, situation of the land, geographical position, and other conditions which vary practically with every farm. It is not feasible in these brief notes to specify individual mixtures, but those concerned are referred to an article by E. Bruce Levy in the *Journal* for May last, detailing a large number of such mixtures for various soils and conditions. Mr. Levy's series of *Journal* articles on the principles of pasture-establishment have been reprinted and published as Bulletin No. 107 (price 1s.), which is obtainable from the Department of Agriculture, Wellington.

On arable land subject to bad infestation of annual weeds, autumn is undoubtedly the best time to sow any form of pasture. The application of some readily available phosphate, such as superphosphate, Ephos, or basic super, when sowing is strongly recommended.

LUCERNE.

Young crops should be ready for cutting for the second time during March. When this cut has been removed the land should be given a few strokes of the tine harrow or a light cultivator to loosen the soil and bring away a vigorous growth before cold weather sets in. If this cultivation is properly carried out it will save much spring work.

March is also a good month for cleaning up established stands that have been neglected, as the weather is usually dry enough to destroy most of the grass and weeds without injuring the lucerne. If the ground is hard and the grass in fairly large clumps good results can be obtained in districts with ample average rainfall by giving one or two cuts of the disk, followed by a cultivator or tine harrow. When using the disks care must be taken to see that they are set as straight as possible. The object is for the disk to break up the surface and large clumps of grass, and the cultivator or harrows can then shake up the land to a proper depth. It is sometimes stated that the use of the disk is harmful, but under the conditions outlined it is a most useful renovator. Some of the best stands in South Taranaki have been disked once a year for a number of years past. Established stands that are free from weeds and in good condition are best left alone.

Stands that are thin and have much bare ground may after this autumn cultivation be sown with a few pounds of Italian rye-grass, or a bushel to a bushel and a half of oats. This will provide early spring feed and occupy the land which would otherwise be growing weeds.

Established stands may be grazed from now until the end of the growing season. Young areas should be allowed to stand through the winter with a fair growth on them.

THE MAIN POTATO-CROP.

The lifting of the main crop should be general in March. Potatoes should never be harvested while the soil is wet, but should turn out clean and free, and if stored in this condition they keep much better. If emptied into a spare shed or room excessive light must be prevented from entering, as they green very quickly, and this spoils them for table use. On the other hand, if they are required for seed-purposes light is advantageous.

In the colder districts the usual method is to pit the tubers in the open by piling them in long heaps—say, a base of 5 ft. or 6 ft. brought up to a point at a height of $2\frac{1}{2}$ ft. to 3 ft.—with the heap any length required. Cover with a good layer of dry clean straw, and again cover with a thick layer of soil brought to a fairly sharp finish at the ridge, the whole being nicely patted smooth with a spade. Ventilators should be made by inserting a few tile drain-pipes along the ridge, or else good wisps of straw, otherwise undue heat may develop and decay set in. Another good method where frosts are not heavy is to tip the tubers in long heaps under a shady plantation or belt of trees (preferably pines or the like) and cover well with straw. In this way they will usually keep very well, and as

ventilation and temperature are good there is little danger of decay. Care must be taken that no diseased tubers are included with those stored for winter.

IRRIGATED LANDS.

Farmers practising irrigation should make provision to carry out the final watering of their land in March, as the supply of water from the races is cut off at the end of the month. This especially applies to the soaking with water of uncultivated ground intended to be broken up during the winter. There is no doubt that by this means ploughing is made easier and more satisfactory. A start should be made to break up new land, and this operation not left until the winter, when, in all probability, the ground will be frozen so hard that ploughing will prove out of the question. This note, of course, has special reference to Central Otago.

FEEDING OF FORAGES.

Early-fed rape will still be providing a fair growth during March, and, like other green fodders if they can be spared, will help to freshen the ewes just before tupping. Soft turnips will be proving useful to the dairymen now, and any surplus of early crops not required can be fed off with sheep.

Maize should be fed with the intention of utilizing it all by the middle of April, as at any time after that frost may occur. Should there apparently be a surplus in view it would be wise to consider making ensilage of this early in April.

Many early-sown green catch-crops will now be making good progress. Barleys should not be allowed to get away, but be fed off in good time to prevent the tendency which this cereal has at this time of the year of shooting into ear.

SUNDRY HINTS.

Grain should be got off the land as soon as possible after threshing. If this is done before the wet weather sets in a good deal of damage to the paddocks and additional work in handling is saved.

If shelter stacks in horse-paddocks are not already provided advantage should be taken at stack-threshing to cart at least one good-sized stack into the paddock where horses are to be wintered. This will provide a picking at nights, as well as shelter, and lend to the general welfare of the teams.

Care should be taken before clover is cut for seed to examine the heads carefully. Often what appears to be a likely paddock for seed has little else but dummy heads in it. The heads from various portions of the paddock may be rubbed out in the hand for this purpose. Good cow-grass seed when mature should show a purplish colour.

March is a good time for cleaning out dams and creeks that are relied upon for water-supply, as well as ditches the main function of which is drainage.

—*Fields Division.*

THE ORCHARD.

THE main orchard harvest is at peak during March. The leading export varieties of apples and many others intended for local markets, also pears, will require to be dealt with. Only the very strictest attention to details, concentration on the work, and a constant amount of hard labour will lead to successful results.

EXPORT POINTS.

With present overseas market prospects every effort will no doubt be made to ship apples of exportable quality. Conditions of the Government guarantee and modifications of the export regulations for the 1924 season have been published, and should be carefully perused by all exporters. Much might be said in general about selection and preparation of fruit for export, but specific local information should be sought from the district Orchard Instructor. Attention may, however, be directed to some of the general outstanding points which may best be dealt with by a caution, as follows :—

Don't pick immature fruit ; don't overfill orchard boxes ; don't expose picked fruit to the sun ; don't handle fruit unnecessarily ; don't fail to discard rejects as picked ; don't use cases that are faulty ; don't use nails of less than 14 guage or $1\frac{1}{2}$ in. long ; don't sacrifice the pack for speed ; don't use wrong-size paper, but consult the list ; don't forget to mark cases correctly ; don't use other than the universal label ; don't use oversize lids ; don't allow wood-wool to protrude from ends of lids ; don't place the wire more than 1 in. from the end of case ; don't allow the wire tie on the corners ; don't allow sag ends to wires, but cut well up to the tie ; don't overload a conveyance until the springs are useless.

FRUIT FOR LOCAL MARKET.

The local-market varieties suitable for cool storage should receive every consideration, prompt handling into store being the first essential towards success. Much of the fruit found unsuitable for export may also be more profitably dealt with later if placed in store meanwhile. Of course, it never pays to rehandle any fruit which was very low in grade ; such rejects should be cleared away as soon as possible by feeding to stock, but there is a grade perhaps not quite up to export standard which may be found quite suitable for some classes of trade on the local markets.

SPRAYING WORK.

Orchard-work proper for March will consist of spraying late varieties of apples and pears with arsenate of lead for codlin-moth and leaf-roller, with the addition of lime-sulphur for red-mite and black-spot or bordeaux instead of lime-sulphur if black-spot is bad. These late coatings of a fungicide are very essential for fruits which are to be later held in an orchard air-cooled store, because they have a restraining influence on the development of fungus troubles under storage. Apple-trees from which the fruit has been picked, if infected with woolly aphis, should be sprayed with oil, 1-60, to deal with the autumn brood of aphis.

Late stone-fruits should be sprayed with lime-sulphur, 1-125, plus 8 pound of atomic sulphur, for brown-rot, &c. Trees from which the fruit has been picked are better sprayed at this period with bordeaux, 3-4-40.

CULTIVATION AND COVER-CROPS.

Where cultivation has been suspended, and the weeds have got ahead, the mower may be used to prevent weeds seeding and make it possible to get about the orchard with greater comfort and efficiency. Where the cultivation has been continuous, or the land can be turned up, early March is a very suitable time for sowing green crops to be turned in next spring. Peas, oats, vetches, and horse-beans are all suitable for sowing, according to locality.

—W. H. Rice, *Orchard Instructor, Hastings.*

CITRUS-CULTURE.

Where citrus-fruits are grown in mixed orchards there will be little time during March to give them much attention, as the most urgent work of marketing other fruit will be on hand. However, there will be no work that requires urgent attention in the citrus-groves beyond the maintenance of thorough cultivation and the harvesting of any fruits yet remaining.

FIREBLIGHT.

The position regarding fireblight in the Auckland District, especially in the commercial fruitgrowing areas as proclaimed under the Fire-blight Act, 1922, may be considered very satisfactory at the present time. Some infection has occurred in the northern part of the district, in localities which are not included in the prescribed commercial areas. A sharp lookout should be kept by all growers, with a view to the immediate identification, removal, and destruction by burning of all infected parts, or infections bearing a suspicious appearance. Although the position is satisfactory so far, it is yet possible, should weather conditions remain favourable to its spread, that further tip-infection may occur, and therefore vigilance should not be relaxed at this period.

—J. W. Collard, *Orchard Instructor, Auckland.*

POULTRY-KEEPING.

CLASSIFYING AND CULLING THE STOCK.

MARCH is the best period of the year for going through the stock for the purpose of weeding out all birds that have passed their most profitable period of production, and also to select the best specimens for future breeding-purposes. It is then, or just before the moulting process commences, that certain signs manifest themselves indicating whether a bird has in the past year been a heavy producer or whether it is likely to be so during the next. In a general way these signs vanish as soon as the birds have moulted. There should thus be no delay in carrying out this important work.

In classifying the stock three grades should be made—namely, future breeding specimens, birds which show indications that they will pay to keep another year, and the culls. The latter should be the first to remove from the flock. There must be no sentiment allowed to enter into this matter. If the maximum return is to be made from poultry no birds (except noted breeding specimens) should be kept beyond the second laying season. One of the great weaknesses, especially on farms, at the present time is that too many birds are kept till they have long passed their stage of usefulness and for years have been practically eating off their heads, being allowed, as a matter of fact, to die of old age. The farmer would not think of continuing to milk a cow that was hardly giving enough milk to rear a calf, or of using an old horse that could not do a decent day's work, but too often he will allow any number of old hens to mope around which are not even paying for their board.

In order to simplify the work of culling, all young birds should be marked in the web of the foot by a special punch made for the purpose. In this way, and by keeping a correct register of such marks, the different ages can be ascertained at a glance and the old birds weeded out at will. This must not be held to imply that it will pay to keep all birds till the termination of their second laying season. In all flocks of one-year birds, no matter how well they may be bred or fed, individuals are to be found that will not pay to keep for the second year.

SELECTING THE LATE MOULTERS.

It is now generally recognized that lateness of moulting is one of the best guides to heavy productive power, but this only applies where the birds are of about the same age and the management received has been uniform in all respects. For example, in a mixed flock of first and second season's layers it will be usually found that the former will moult first. Especially is this the case where the older birds were selected the previous season as late moulters. Then again, where a flock has recently been subjected to violent changes of food or change of quarters the good layer is apt to moult early, as is the case with the poor layer. It will thus be seen that local conditions should always be taken into consideration when classing stock according to their time of moulting.

General appearance : This, apart from the question of the time of moulting, gives a good guide in determining a bird's productive power. The heavy layers will present a more or less shabby appearance, and owing to this fact are often the first to be culled out by the inexperienced poultry-keeper. In white-coloured breeds the plumage will usually be more of a straw colour than a white, while in the case of black birds the feathers surrounding the thighs and abdomen will bear a more or less rusty appearance. Birds with a well-kept, glossy plumage, and which are usually well above the ordinary weight of their breed at this period of the year, are flesh-makers, and should therefore be culled out. The good layer is always tight and thickly feathered. Not only does loose feathering denote poor laying-capacity but an impaired constitution as well.

Head-points : The head of a bird is a good guide in the selection of stock. The good layer will show a clear face free from wrinkles

and feathers. Indeed, with the exceptionally heavy layer it is not uncommon for the head to become completely devoid of feathers towards the termination of her laying season. Of course these are always renewed at moulting-time. The eye of the heavy producer is round and prominent, and presents a fiery expression. In short, the head should be neat but moderately deep and broad, with a stout well-curved beak. Birds with coarse heads, long thin beaks, heavy feathered eyebrows, dull sunken eyes, and wrinkled skin surrounding the eye, mostly indicate poor egg-capacity and low vitality.

The pelvic bones: While the width of these gives no guide to productive power, their condition will serve as a guide to the novice in the work of culling. When a bird commences to lay these bones expand to a more or less greater degree, but when the bird is about to take a rest they contract. Thus, with say, a two-year-old bird it is intended to cull at the end of the present laying season, and where the bones are found close together, it may be safely assumed that it is not laying or likely to in the near future, and it can be weeded out accordingly.

The abdomen: The condition surrounding the abdomen gives probably the best guide of all to laying-capacity. In the good bird it will be found full, pliable, and soft to the touch. Of course, the abdomen is not the egg-basket, but the development of the egg-cluster or ovary, which is situated much higher up, causes the intestines to fall, and consequently a fullness of the abdominal region occurs. Therefore when the abdomen appears to be full and is soft to the touch it may be taken for granted that the egg-cluster is in an active stage of development, and that the bird is either laying or on the point of it. On the other hand, the abdomen of the low producer will be found more or less shrunken, besides being thick and hard to the touch.

SELECTING THE BREEDING-BIRDS.

Having removed all the culls from the flock, the next important step is to choose the prospective breeders. In this connection I cannot emphasize too strongly that the best layer is not necessarily the best breeder. The danger of improving one character by weakening another should always be kept in mind. In addition to possessing a maximum of laying-points the ideal breeding-bird should be at least a fair specimen of the breed it represents. In other words, it should conform to breed-type. If a heavy-producing strain is to be built up or maintained it is imperative that the breeder shall have an ideal type to aim for pictured in his eye. Egg-record alone will never achieve this end. Above all, only birds which conform to standard weight requirements, and those which lay a decent-sized marketable egg, should be bred from.

For a bird to produce desirable progeny for the maintenance of a heavy-laying strain it is essential for it to have some "timber" about it. Not only should the back be broad, but there should be a great depth of body, well developed in front and in the abdominal region. The small-egg question is becoming a serious matter, especially in view of the fact that nothing under a 2 oz. product is suitable for the export trade. There is no better way of raising the standard of eggs

than by eliminating from the breeding-pens diminutive specimens of a breed. These latter, by the way, are too often bred from throughout the Dominion to-day.

In the case of novices and those who have not had much experience in the selection of breeding-stock, I would advise them, if they have not already done so, to obtain a copy of the New Zealand Utility-poultry Standards. This booklet is obtainable from the Department of Agriculture, Wellington, at a cost of 3s. The illustrations contained therein of the ideal types of the various breeds will serve as a guide in selecting the most desired class of bird to breed from for the production of a uniform flock.

MANAGEMENT OF THE BREEDING-BIRDS.

After selecting the most desirable specimens for future breeding-purposes the birds should be carefully marked and kept by themselves. This is in order that they may be specially attended to. The food to be provided at this stage is most important. On no account should the birds be forced for egg-production. On the contrary, an endeavour should be made to retard egg-production by providing a plain ration or by frequent changes of diet. This will induce the birds to moult and give them an opportunity to recoup. True, there will be a loss of eggs just at a time when the price of the latter is advancing; but any loss in this way will be easily made up by the fact that they will commence their next laying-season much earlier and when eggs from adult stock are most desired for the production of early chickens. Too many poultry-keepers depend on pullet-eggs for the production of early chickens, owing to the adult birds not coming on to lay at the desired time. This is a weak practice, and if continued from generation to generation it is more than probable that the stock will decline in size and constitutional vigour and be layers of second-grade eggs.

—F. C. Brown, Chief Poultry Instructor.

THE APIARY.

FINAL EXTRACTING.

BEFORE taking the last of the surplus honey a careful examination of the colonies must be made in order to ascertain the amount of stores available for wintering the bees. Too often beekeepers err in extracting too closely, and feeding has to be resorted to at a later period to make up the amount required to prevent starvation. It takes 30 lb. of honey to winter a colony successfully, and if this amount is increased to 40 lb. there is less likelihood of the bees being short in the spring, while the beekeeper will also be saved a great deal of anxiety and endless trouble in the way of feeding.

Where extracting has been delayed for any reason it is advisable to use great caution in removing the honey. The combs should be removed as expeditiously as possible, and care must be exercised not to incite the bees to rob by keeping the hives open longer than it is necessary to remove the surplus. A hasty examination of the brood-chamber should be made if it is found that the bees have not filled the

combs in the lower story with honey. If empty or partly filled combs are found it is highly important that they be replaced with good combs of honey from the super. On no account attempt to extract any honey from the brood-chamber. Do not leave combs lying about or expose vessels that have contained honey. Unless caution is exercised in regard to these details, when the final extracting is being done the beekeeper is more than likely to start the bees robbing in a wholesale manner.

BEE-ESCAPES.

For removing honey late in the season the beekeeper may find it necessary to bring into use bee-escapes. These escapes enable the honey to be removed without causing any disturbance. By the employment of the Porter bee-escape there is less likelihood of causing robbing, with its attendant evils. More especially will the escapes be found advantageous when removing section honey from the hive. There is far more risk in removing comb-honey from the hive than extracted honey. When the colony is disturbed the bees will at once start to fill their sacs, and often the cappings of the sections are punctured in order to secure a supply of honey. The damage to the cappings of sections is unsightly, and causes the honey to leak after removal from the hive. The escapes are fitted to a board of the exact dimensions of the hive in use. In inserting the board gently prize up the super from the brood-chamber and insert the board. A puff of smoke will suffice to control the bees while the operation is being performed. If this is done late in the afternoon the bees will pass through the escape during the night to the brood-nest, and will be unable to return. In the morning the supers may be removed, when practically no bees will be left in the super.

A word of caution to those who have not formerly used the escapes: Should there be brood in the super-combs the bees will not leave, and the escapes will not prove effective in ridding the supers. Over and over again many beginners complain that they cannot get the bees to leave the supers when using escapes, but the reason lies in the fact that no examination had been made to ascertain beforehand whether the super contained honey only.

UNITING COLONIES.

Among the autumn work to be attended to is the examination of the colonies for the purpose of ascertaining if each possesses a laying queen, and to note those that are too weak to survive the winter. In the negative in either case it is advisable to unite with a stronger colony to save the bees. On no account should an attempt be made to winter weak hives, as they are likely to get robbed out, and this may cause the bees to start robbing when everything in the apiary should be quiet. A simple method of uniting may be practised by placing the weaker hive on top of a stronger one, and placing a sheet of newspaper between the two hive-bodies. In the course of a few days the bees of the weaker colony will gain their way through the paper and unite peaceably with the bees in the stronger hive. The surplus combs may subsequently be removed and reserved for spring feeding if required. It is advantageous to destroy the queen in the weak hive prior to uniting.

ROBBING.

At the close of the honey-flow the beekeeper must persistently guard against robbing. Robbing is the result of carelessness, and once it has started is exceedingly hard to check. As previously mentioned, neither honey, sugar-syrup, nor anything that the bees can rob should be exposed. In case wet combs have to be returned to the hives for the bees to clean up, postpone this operation until late in the day, when robbing is not likely to start. See that the honey-house is bee-proof, and that all combs and vessels containing honey are removed to a place of safety. Contract all hive-entrances, and especially guard against hives being open in a way that they can be attacked by robbers. All operations must be carried out quickly. If robbing has started it is better to postpone all outside work until the apiary is quiet again than to risk extending the trouble by opening the hives. Should a colony be attacked, contract the entrance and pile wet grass in front of the hive. This will usually cure mild cases of robbing, but where a colony has been overpowered by the robbers it should be closed altogether.

—E. A. Earp, *Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

After the dry summer, winter crops (cabbage, broccoli, celery, &c.) are probably a little backward, and would benefit from a second light dressing of nitrate of soda. Hoe between the rows on bright dry days to keep the weeds down. The celery must not be allowed to suffer from want of water. Allow the plants to make almost full growth before earthing up, and for this operation choose a fine day when the soil and plants are dry. Keep the soil from the hearts of the plants, and do not pack the soil too tight.

Harvest crops as they reach maturity. Cut pumpkins before the rind gets too hard, and allow them to remain for a few days where they grew; then store them in a dry airy place.

Clean up and burn all litter as it accumulates. Some growers pull their tomato-plants when finished and leave them on the sticks or strings to dry before they are gathered and burnt—a very good practice. Land that is not going to be cropped immediately is best sown down with a cover-crop. White mustard, oats and vetches, or oats and horse-beans are often used with good results.

Glasshouses in which a tomato crop affected with rust or mildew has been grown should be well sprayed with a fungicide before sowing down. Even the "strings" might well come under suspicion and receive attention. Give ample ventilation at this season.

Sow turnips and spinach for winter use, also lettuce and cabbage for early spring cutting, and towards the end of March sow cauliflower seed.

SMALL-FRUITS.

Preparation of the land for new plantings should now be proceeded with ; success depends on initial preparation more than on any other factor. Harrow, cross-plough, and subsoil, thus ensuring a deep clean tilth, incorporating also a generous application of manures. In the absence of the usual organic manures a good application of bonedust and potash will usually meet the case. If the surface is at all lumpy or uneven use a clod-crusher ; besides breaking the clods it will smooth the surface and facilitate planting.

Where the intended crop is strawberries secure the plants as early as possible—probably towards the end of March—and plant them without delay, so as to get them well established before the winter. Plant ordinary varieties 12 in. to 16 in. apart, with 24 in. to 30 in. between the rows—planting them firmly.

Carefully look over brakes of gooseberries, currants, or raspberries ; although the crop is gathered they require close attention so that the buds may set well for next year. Too often the foliage drops prematurely through disease, or from the same cause becomes shabby and discoloured. Clean and well-coloured foliage is required up to the end of the season to set the buds well and ensure a satisfactory crop next year. Where rusts or anthracnose, borers, or bud-moth are troublesome one or two applications of bordeaux with arsenate of lead (summer strength) would be of great advantage. In the case of raspberries remove and burn the old canes first.

FLOWERS AND LAWNS.

Autumn rains falling on soil heated by the summer sun soon quicken growth in most kinds of vegetation. Lawns will require more frequent cutting to keep them short and of good colour ; bare spots may be raked up and sown with seed, and top-dressed with fine soil. A thin turf will be much improved by a dressing of basic slag or other good fertilizer applied now. Where new lawns are to be laid the surface should be graded to drain water away from the house. Rake the surface smooth and fine and make it firm by rolling. Another stroke of the rake will be required before broadcasting the seed, of which from 5 lb. to 6 lb. will be required for 200 square yards. A further stroke of the rake will complete the job.

Seedling flowering-plants raised from seeds sown last month will require to be thinned or pricked out into beds or boxes of rich soil, with a view to obtaining good strong plants for putting out into permanent quarters towards the end of March.

That period is also a good time to make alterations in the herbaceous sections. Old clumps may be lifted, trimmed back, and broken up and replanted. Before planting give the land thorough preparation—manuring, and trenching if possible. The arrangement and grouping of these plants affords opportunity for the exercise of taste. Rather large grouping in the vicinity of shrubs and trees can be made very effective.

Complete the planting of spring flowering bulbs as soon as possible.

—William C. Hyde, Horticulture Division.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

LIVE AND DEAD WEIGHT OF SHEEP AND LAMBS.

"STOCK," Kelso :—

Would you please let me know the difference between live weight and freezing-weight of lambs and wethers ?

The Live-stock Division :—

From practical tests it has been ascertained that the difference between live and dead weight and freezing-weight varies slightly, but usually runs somewhere about 50 to 55 per cent. In a test at a freezing-works in Canterbury some few years ago ten average sheep and ten average lambs were killed, with the following results : The average live weight of the sheep was 109½ lb.; the dressed weight warm was 56½ lb., the dressed weight cold 55½ lb., and the freezing-weight 53½ lb. The percentage of dead to live weight was—warm, 51·4; cold, 50·5; and frozen 48·2. The average live weight of the lambs was 67½ lb.; the dressed weight warm, 36½ lb.; the dressed weight cold, 36½ lb.; and the frozen weight 34½ lb.

LAYING DOWN A LAWN.

A. H. FLAY, Te Awamutu :—

Will you please give me information regarding the laying-down of a lawn on ordinary loam soil of the Waikato? I should like to know how to prepare the soil, the best grasses to use, and the manure requirements.

The Horticulture Division :—

Growing a crop of potatoes is an excellent preparation for the ground before laying down a lawn, the necessary cultivation breaking up and sweetening the soil. Care should be taken, however, to leave as few of the tubers as possible in the ground, as they break up and disturb the young grass. The area should now be dug over and levelled as nearly as possible. It should then be well rolled; this will crush lumps and show hollows. The surface should then be raked over, the hollows being filled as the work proceeds. Roll again, and if the surface is free of lumps it will be ready for the seed. If there still are lumps these must be broken up, first by raking with a sharp rake, then rolling again. Allow ½ oz. of seed for each square yard. Scatter the seed evenly and lightly rake it in, then roll again. If the soil is at all clayey the last rolling should be left until the grass is up. Suitable grasses are *Poa pratensis*, fine-leaved sheep's fescue, and crested dogtail, used in equal proportions. A dressing of basic slag, 4 cwt. to 6 cwt. per acre, may be given before sowing. The best time to sow is during the month of March, to ensure a good sward being secured before winter sets in.

CONTROL OF BLACKBERRY.

"SUBSCRIBER," Waihi :—

Will you please inform me as to the best way to cope with the blackberry pest ?

The Live-stock Division :—

The method that can be most advantageously applied will depend to a great extent upon the condition of the land on which the weed is growing. Cultivation of the infested land is easily the most effective method of eradication where it can be applied, and in the long-run it is also the cheapest method. Where an area of blackberry-infested land is broken up it should be kept under cultivation with suitable crops until the whole of the roots are removed. On land which

cannot be cultivated blackberry may be kept under control by any of the following methods: (1) Cutting followed by burning; (2) spraying with a weed-destroying preparation; and (3) stocking with goats. When cutting is adopted the best results are obtained by doing the work after the fruit forms, provided, of course, that the latter is not permitted to ripen. If a fire can be put through the blackberry about six weeks after it has been cut, the result will be much more permanent, as the burning of the young shoots at that time is very weakening to the plants. Spraying with a weed-destroying preparation is often resorted to as a means of killing the vegetation so that the weeds may be burned. If adopted as a means of eradication spraying must be carried out at intervals sufficient to prevent young shoots from making leaf. The best time to commence spraying is when the plants are in flower. When goats are used as a means of control secure fences are necessary, in order both to keep them on the infested area, and to avoid trouble with neighbours.

COWS RETURNING TO BULL.

N. B., Motueka:—

We have several cows that have returned to the bull, some as many as four times. These cows have been washed out each time, and two have returned after holding for six weeks. We also have several cows we are not putting to the bull, and have noticed that about three or four days after being on heat there is a fair amount of blood discharged from the vagina, both from the cows that have been to the bull and the ones that have not. Will you kindly advise in the matter?

The Live-stock Division:—

Both after contagious abortion and in catarrhal vaginitis this continual "coming back" is a constant occurrence. As you do not mention having had abortion in your herd, the probability is that contagious vaginitis is present. An examination of the vaginal passages should be made—first in those affected, and then, after thoroughly cleansing the hands, of those apparently sound. If affected, the passages have a red, angry appearance, and on the surface are small elevations which are quite appreciable to the finger. Usually, owing to the irritable condition, the animals do not appreciate handling. Frequently there is a discharge accompanying the trouble, and there may be some ulceration. The "bulling" in many cases is not true bulling, being due to the irritation set up, and many cows which have apparently come back may be actually in calf. An article on vaginitis in cows was published in the April, 1923, *Journal*, and reference to it would give you further useful information.

IMPORTATION OF FERTILIZERS: DECEMBER QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the quarter ended 31st December, 1923: *Sulphate of Ammonia*: United Kingdom, 25 tons; Australia, 83 tons: total, 108 tons. *Gypsum*: Australia, 800 tons. *Nitrate of Soda*: Chile, 450 tons. *Basic Slag and Thomas Phosphate*: United Kingdom, 100 tons; Belgium, 750 tons; France, 25 tons: total, 875 tons. *Bonedust*: India, 525 tons; Australia, 840 tons: total, 1,365 tons. *Guano and Rock Phosphate*: United Kingdom, 20 tons; New Caledonia, 2,881 tons; Ocean Island, 6,900 tons; Makatea Island, 9,766 tons; Nauru Island, 6,330 tons: total, 25,897 tons. *Phosphates, other*: Egypt, 2,196 tons. *Kainit*: United Kingdom, 150 tons; France, 260 tons; Germany, 285 tons: total, 695 tons. *Sulphate of Potash*: United Kingdom, 15 tons; France, 20 tons; Germany, 25 tons: total, 60 tons. *Potash, other*: France, 5 tons; Germany, 5 tons: total, 10 tons. *Sulphate of Iron*: United Kingdom, 5 tons; Australia, 13 tons: total, 18 tons. *Manures, other*: United Kingdom, 1 ton.

Apple-packing Standards for Local Market.—The apples of Commercial A grade are to be packed not less than 200 to the bushel case—not 220 as printed on page 70 of last month's *Journal*.

WEATHER RECORDS: JANUARY, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE weather in January, though warm and dry on the whole, was marked by distinctive changes. The troughs of at least five low-pressure areas passed in the South from the 1st to the 15th, and until the 13th the weather was very warm, muggy, and wet in the west coast districts, but hot and dry in the east-coast districts. There was a cold snap for a few days about the middle of the month, but a more easterly and summery type of weather followed. This prevailed until toward the close of the month, when a moderate westerly disturbance made its appearance in the South.

The rainfall was above the average at most stations along the western coast and the higher levels of the South. Kaitaia, in the far North, had percentages of 125, Arthur's Pass, 225 and Queenstown 152 above the mean January rainfall: and Lake Wakatipu was much above flood-level for several days.

In the east coast districts the dry conditions which had been prevalent mostly since the middle of October caused considerable trouble until the middle of the month, when a bountiful rainfall was reported in most parts of the country, and showers were also experienced later. In most parts of the east coast the total rainfall, however, was from 30 to 50 per cent. below the mean January fall.

High westerly winds were experienced, especially about the 13th, 14th, and 15th, when considerable damage was done to orchards.

—D. C. Bates, Director.

RAINFALL FOR JANUARY, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches
Kaitaia	7.85	9	3.75	3.30
Russell	2.82	11	1.12	4.54
Whangarei	2.88	16	0.74	3.63
Auckland	3.85	13	2.37	2.59
Hamilton	2.45	13	1.10	3.70
Kawhia	1.89	9	0.45	3.37
New Plymouth	3.84	11	0.88	4.32
Inglewood	7.98	13	2.32	7.43
Whangamomona	5.85	17	0.87	5.82
Tairua, Thames	2.02	7	0.90	4.12
Tauranga	2.77	18	1.12	4.40
Maraehako, Opotiki	4.80	8	2.62	2.87
Gisborne	3.43	11	1.34	2.77
Taupo	3.18	13	0.82	3.46
Napier	1.67	8	0.56	2.44
Maraekakaho, Hastings	1.23	8	0.47	2.39
Taihape	2.52	13	0.78	3.03
Masterton	1.67	10	0.50	2.62
Patea	4.63	10	0.98	3.38
Wanganui	1.90	6	0.74	2.84
Foxton	1.92	8	0.68	1.99
Wellington	2.24	12	0.48	3.32
<i>South Island.</i>				
Westport	7.93	19	1.50	6.80
Greymouth	12.79	19	2.18	9.04
Hokitika	16.72	20	2.74	9.87

RAINFALL FOR JANUARY, 1924—continued.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average January Rainfall.
<i>South Island—continued.</i>				
	Inches.		Inches.	Inches.
Arthur's Pass	23·94	15	4·63	6·75
Okuru, Westland	17·80	16	2·88	12·86
Collingwood	5·48	8	2·66	6·95
Nelson	1·43	8	0·46	2·71
Spring Creek, Blenheim	0·55	5	0·23	2·22
Tophouse	4·39	10	0·77	5·16
Hanmer Springs	4·52	11	1·53	3·30
Highfield, Waiau	3·00	5	1·22	2·84
Gore Bay	4·07	7	2·02	2·47
Christchurch	1·92	10	1·19	2·15
Timaru	0·84	8	0·42	2·28
Lambrook, Fairlie	2·44	7	0·86	2·34
Benmore, Omarama	2·94	11	0·60	2·66
Oamaru	1·36	6	0·85	2·15
Queenstown	6·83	14	1·24	2·71
Clyde.. .. .	3·22	10	1·06	1·72
Dunedin	2·49	12	0·80	3·41
Gore	2·51	12	0·84	3·34
Invercargill	4·30	14	1·10	4·14

FORTHCOMING AGRICULTURAL SHOWS.

Franklin A. and P. Society: Pukekohe, 22nd and 23rd February.
 Rotorua A. and P. Association: Rotorua, 27th February.
 Opotiki A. and P. Association: Opotiki, 27th February.
 Tauranga A. and P. Association: Tauranga, 28th February.
 Waipu Agricultural Association: Waipu, 28th February.
 Omaha and Pakiri A. and H. Society: Leigh, 1st March.
 Taumarunui A. and P. Association: Taumarunui, 5th March.
 Taranaki Metropolitan Agricultural Society: New Plymouth, 5th and 6th March.
 Waikato Central Agricultural Association: Cambridge, 5th and 6th March.
 Mangonui County A. and P. Association: Kaitia, 8th March.
 Morrinsville A., P., and H. Society: Morrinsville, 12th March.
 King Country Central A. and P. Association: Te Kuiti, 13th March.
 Hawke's Bay A. and P. Society: Hastings, 18th and 19th March.
 Mayfield A. and P. Association: Mayfield, 22nd March.
 Methven A. and P. Association: Methven, 27th March.
 Temuka and Geraldine A. and P. Association: Winchester, 3rd April.
 Manawatu and West Coast A. and P. Association: Palmerston North (Winter Show), 17th, 18th, 19th, and 20th June.

(Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.)

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 2nd February:—*Peas*—Arrivals of blue are heavy from Japan, but market firm and £23 per ton c.i.f. has been paid for February–March shipments; spot prices, Japanese, £21 15s.; Tasmanian, £22; New Zealand, £17 to £21. Demand for maple is limited and New Zealand stocks heavy; New Zealand, 73s. to 75s. per 504 lb.; Tasmanian, 90s. to 95s.; Tasmanian February shipments, nominal values 90s. c.i.f. English selling freely at 55s. to 65s. *Beans*—Market quiet; Home trade at 45s. to 50s. per quarter

IDENTIFICATION OF PUREBRED STOCK.

INQUIRIES continue to be received by the Department as to the best method of identification for purebred stock. The Director of the Live-stock Division unreservedly recommends the nose-print method, specimens of which—taken at the Wallaceville Veterinary Laboratory farm—were reproduced in the *Journal* for June last (pages 380, 381). This method is simple, and is not open to faking as is the case with brands. It can be used for cattle, sheep, and pigs. Under this system an animal can be bought on pedigree without having been seen, and identification established on receipt by taking a nose print and comparing it the one furnished by the seller.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* of 24th January and 7th February, 1924, include the following of agricultural interest:—

Milking-machine teat-cup (G. S. Gordon, Helensville); appliance and process for cooling and aerating milk (J. W. Bott, Coalstown Lakes, Queensland); plough-strengthening device (R. Forsman, Gordonton); harrow (Farmers' Co-operative Motor and Wheelwright Co., Ltd. (Morrinsville); cream-separator driving-gear (C. F. Shaw, Rawene); reinforced concrete fencing-elements (W. G. Grant, Otorohanga); sheep-shearing-machine-gear control (J. D. Morrison, Greytown); grass- and clover-seed stripper-beaters (J. E. Holland, Christchurch); animal-skinning apparatus (Société Industrielle de Dépouille Mécanique des Animaux, Paris); milking-machine teat-cup holder (A. M. Hooker, Carterton); cream-testing bottle (M. L. Rogers, Rangiwhia); milking-machine (C. L. Piner, Belfast); milk-can-filling distributor (O. W. Rowe, Whakamara); churn (R. W. Ashcroft, Auckland); milking-machine valve (J. G. Swanson, Masterton); carcase-tail securing appliance during freezing-process (F. Lomas, Murtoa, Victoria); milking-machine milk-measuring appliance (J. W. Fuge, Featherston).

Copy of full specification and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s.

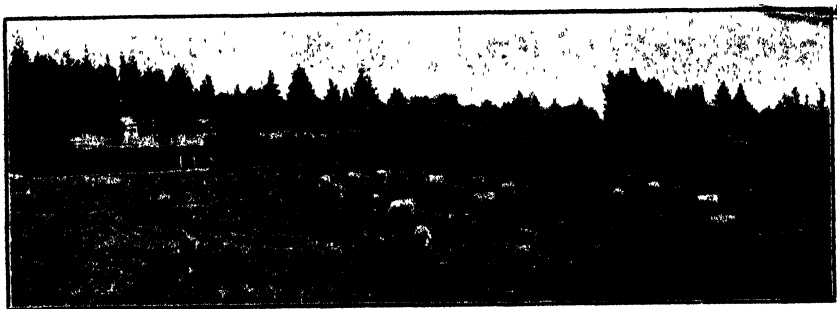
ESTIMATED YIELDS OF WHEAT AND OAT CROPS.

THE following estimated average yields per acre of wheat and oats for the season 1923-24 have been compiled by the Government Statistician from reports furnished by Inspectors of the Department of Agriculture throughout the Dominion, and issued under date 5th February:—

District.					Wheat. Bushels per Acre.	Oats. Bushels per Acre.
North Island	..	..	..	..	24.83	27.75
Nelson	..	..	..	..	21.07	24.00
Marlborough	..	..	..	..	24.86	33.53
Canterbury	..	..	..	..	22.72	27.12
Otago	..	..	..	..	23.92	26.81
Southland	..	..	..	..	30.51	37.60
Average (estimated) for the Dominion, season 1923-24					23.27	29.66
Average (actual) for the Dominion, season 1922-23					30.44	39.74

In accordance with the above estimates, the total yield of wheat for the Dominion should be approximately 4,250,000 bushels, as against an actual yield of 8,395,023 bushels for the season 1922-23 (when also a greater acreage was sown).

The percentage of oat crop threshed for the five seasons ending with 1922-23 was 31.69 of the total area under that crop. Assuming that a similar proportion is threshed this year, the total yield of grain should be approximately 4,200,000 bushels, as against an actual yield of 5,688,157 bushels for the season 1922-23.



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IRRIGATION AND ITS PRACTICE.

I. THE CENTRAL OTAGO REGION AND SCHEMES.

R. B. TENNENT, N.D.D., Instructor in Agriculture, Dunedin, and J. R. MARKS, A.M.Inst.C.E., M.N.Z.Soc.C.E., Resident Engineer, Public Works Department, Alexandra.

THE arid to semi-arid region of Central Otago extends over about 5,000 square miles, comprising the interior of the southern portion of the South Island where the Island attains its greatest width. Of this area 75 per cent. is mountainous country, not suitable for agriculture or other classes of intensive farming, but is used for sheep-grazing, being mostly held in large areas of several thousand acres each for that purpose. The remainder of the district demands only irrigation and close settlement to become one of the most highly productive districts in the Dominion.

In its early history Central Otago gained prominence and great notoriety when gold was discovered in the beds of several rivers. A rush of miners from every part of the Dominion and from other countries took place, small communities of eager gold-seekers rose up all over the country, and from being a district inhabited by only a few pastoralists, it was in a very short space of time changed into one of hustling excitement. Races necessary to convey water to sluicing claims far removed from the rivers were constructed with unwearying patience until they extended in a network of small channels all over the country.

In due course the gold boom died a natural death, and the floating population attracted to Central Otago by the gold lure gradually drifted away. A few miners living in hope or too old to break fresh trails remained on their claims, but, finding that the amount of gold procurable would barely suffice to keep them in food and clothing, were forced to augment their scanty earnings by the growth of vegetables and such produce as they required for their own use. Realizing from bitter experience the futility of depending upon the rainfall for moisture sufficient to the needs of their crops they utilized the water-races primarily designed to facilitate the extraction of gold from the soil for the purpose of conveying water to their crops in time of drought. This then, was the birth of irrigation in Central Otago.

At a later date two officers in the Public Service* were deputed to report on the possibilities of systematic irrigation in this dry region. As a result of their observations they came to the conclusion that over a quarter of a million acres of land were capable of being irrigated, and pointed out that such land if so treated would probably yield very satisfactory results. There can be no doubt that this estimate was very conservative, and it is quite safe to say that between four and five hundred thousand acres of suitable land are irrigable.

From time to time small streams have been dammed or diverted from their original course and spread over the adjacent land, with the result that the present-day traveller in Central Otago, wending his way through arid areas, meets the refreshing sight of snug orchards with trees bearing fruit comparable with the finest in the world, and comfortable farms growing a wealth of lucerne and other crops, these being the outcome of individual effort and a realization of the efficacy of applying water to the soil.

Unfortunately, it is not possible for each and every settler in the district to have an ever-flowing stream for his own private use, and consequently if no assistance were given by co-operative endeavour Central Otago would be in fifty years' time much as it was fifty years ago. During the past decade, however, considerable progress in agricultural development has taken place, and this has been the direct outcome of the application of water to the land. Facilities for doing this have been afforded by the establishment of several fairly comprehensive Government irrigation works, and numerous smaller private schemes. The amount of public money thus expended will undoubtedly prove of national benefit; but having inaugurated the irrigation works and delivered the water to the farmers it now remains to be shown how most judiciously that water may be utilized, what crops are best grown under irrigation, and the most practicable methods of applying the water to crops on different grades and types of land.

Although irrigation farming is older than any other kind of highly developed agriculture in the world, it is nevertheless a fact that the average settler in New Zealand has had no experience in its practice. Since the advent of irrigation in Central Otago people of all sorts and conditions have been coming there to take up land.

* J. L. Bruce and J. H. Dobson, "Irrigation in Central Otago," 1909.

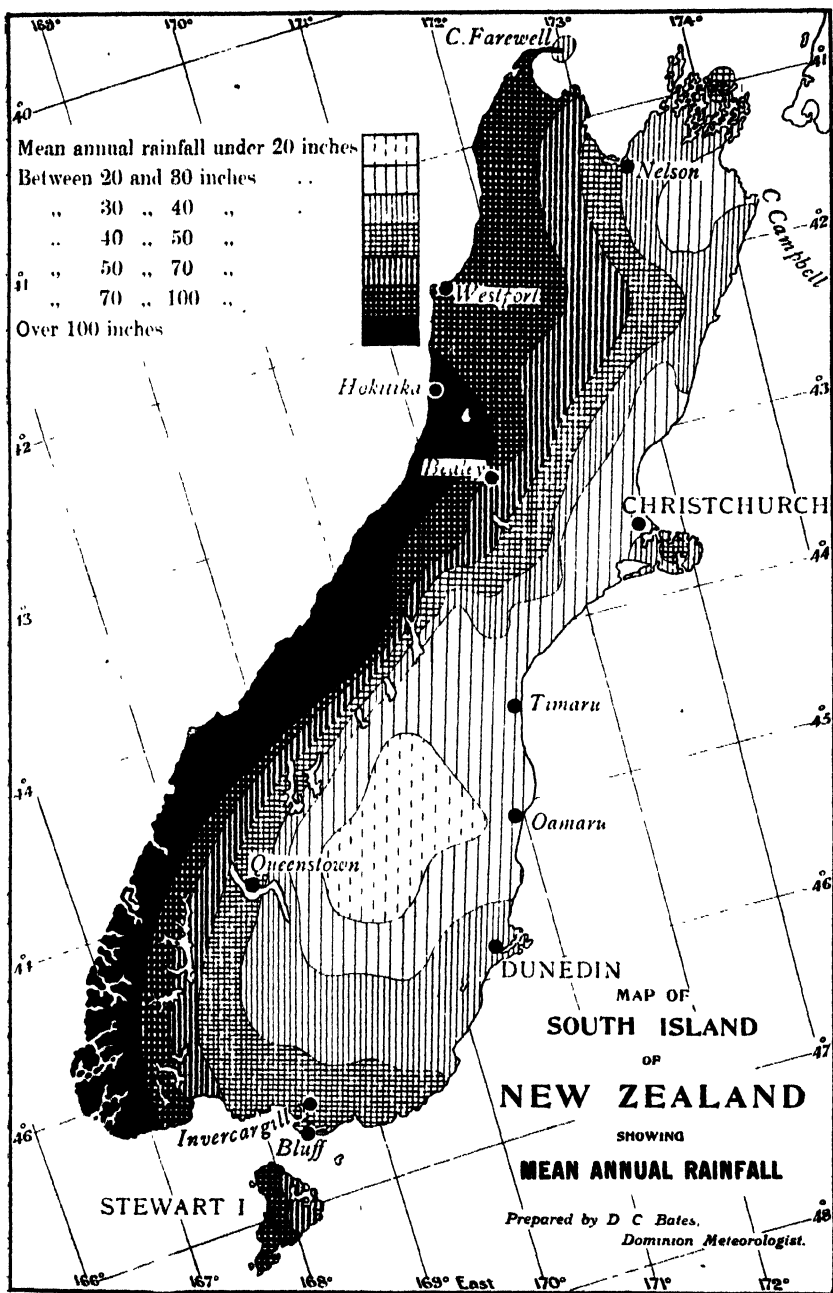


FIG. 1. SHOWING THE CENTRAL OTAGO DISTRICT ON THE LOWEST SCALE OF RAINFALL IN THE SOUTH ISLAND.

Most of them come with the purpose of making comfortable homes on the land and of earning a living by farming, but one finds among them many individuals who know little or nothing of farming, as well as those who lack the physical qualities necessary to cope successfully with the varying conditions of a settler's life.

It is not generally recognized that it takes as much capital and more agricultural skill to develop and bring into production an irrigated farm than is required to successfully farm in a humid district. The need of a fairly comprehensive series of articles dealing with irrigation in Central Otago has been felt for some time past, and with this object in view the present writers have undertaken to prepare such matter in the hope that it will be of use to irrigators, by presenting to them in simple condensed form the fundamental principles of irrigation and the practical application of those principles to their daily work on the farm.

DESCRIPTION OF CENTRAL OTAGO.

A brief description of the area dealt with in this article will be of use to intending settlers, and a glance at the general map of Central Otago (Fig. 2) will serve to illustrate the chief irrigation localities. This map shows, enclosed within a circle of approximately forty miles radius, with Clyde as its centre, what might be termed the semi-arid region of Otago. The country is intersected by ranges of mountains between which are valleys rich in fertile soil. These valleys lie at an altitude varying from 500 ft. to 1,500 ft., and to this may be attributed the variations in climatic conditions which exist throughout the district.

During winter heavy falls of snow occur on the mountain ranges. This naturally conserved water, in the form of snow up on the high country, gradually becomes available for use in the valleys as the warm season approaches. Were it not for the fact that heavy falls occurred, then the difficulty of obtaining water for irrigation purposes would practically prove insurmountable. As it is each valley is traversed by a river, and in spring numerous smaller streams rush down the mountain-sides. The damming of such streams and the conservation of their water-supply is one of the problems with which the irrigation engineer is confronted; it is the regulation of such streams by dams which assures the settlers in the valleys of a continuous supply of water for their crops throughout the dry season.

Central Otago may be regarded as fairly well equipped in the matter of roads and railways. The formation of roads in this district is a comparatively easy matter, due to the presence of splendid road-forming gravel which exists everywhere, and to the natural drainage of the porous subsoil, which allows the surface of the roads to dry almost immediately after the cessation of rain.

From an economic point of view it is of interest to note that trees are practically non-existent in this region (Fig. 3), but for fuel purposes nearly every township has in close proximity deposits of lignite of a fairly good quality. Electric power and light is already being supplied to settlers in certain portions of the district, and the reticulation of other areas and townships is in progress. Lime deposits do not occur

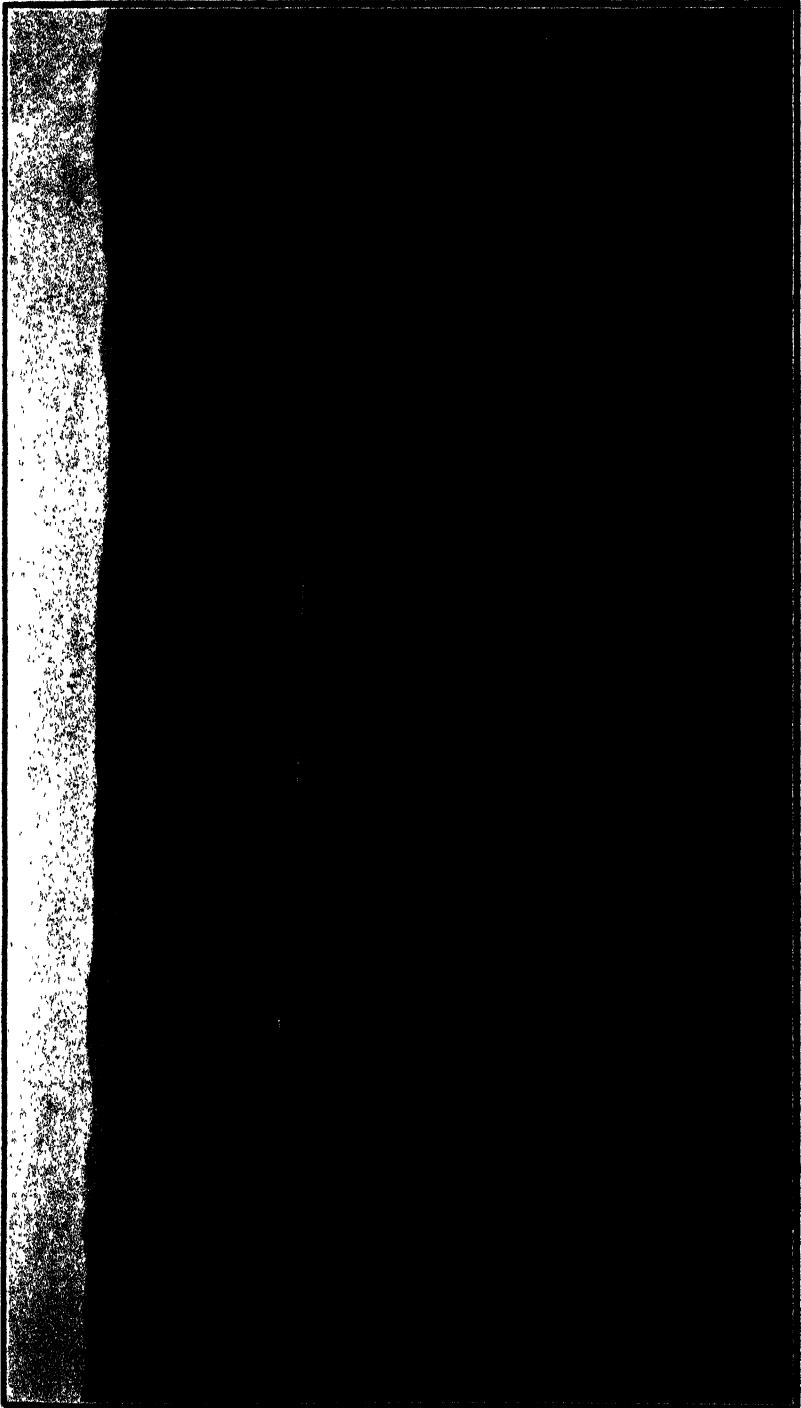


FIG. 3. VIEW OF IRRIGABLE COUNTRY IN CENTRAL OTAGO, SHOWING TREELESS CONDITION AND NEED FOR SHELTER-BELTS.

in great number, there being, as a matter of fact, a scarcity in this respect. On the side of Lake Wanaka there is a fairly large deposit of limestone of good quality, which is frequently used by farmers in the immediate neighbourhood, and there is no doubt that in the future provision will be made to enable irrigators to procure abundant supplies from this source. An interesting and important deposit also occurs at the south end of Lake Hayes (Fig. 4). Professor Park, reporting on this deposit, states that "the material is excessively fine in texture, and so soft as to be easily excavated by a spade without exercising much force. Its purity and pulverent form renders it of great economic value for agricultural purposes, both for dressing the land and in the manufacture of manures."



FIG. 4. LIMESTONE DEPOSIT, LAKE HAYES.

Soil Conditions.

The plains and river-terraces of Central Otago have been built up of the softer portions of the metamorphic schists, forming deep mica-schist soil which responds in a wonderful way to cultivation and irrigation (Fig. 5). The fertility of the soil is notorious, and appears to be the outcome of a happy combination of physical and chemical characteristics. Captain Hutton, F.R.S., in 1875 ("Report on the Geology of the Goldfields of Otago," page 95) stated that "the soils of Otago taken as a whole are decidedly above the average in quality, and this appears to be owing to the great extent of mica-schist exposed at the surface, the decomposition of which has supplied more or less directly almost all the soil in the province. That this schist contains a considerable amount of lime is proved by the incrustation in nearly

all the caves occurring in it; and the good quality of the soil derived is well seen in the Dunstan district, which is remarkably fertile when irrigated."

Mr. B. C. Aston, writing in the *Journal* for June last, gives it as his opinion that "the fertility of the mica-schist soils of Otago is due not to lime or potash or to the total amount of phosphoric acid they contain, but to the comparatively large amount of available phosphoric acid present, a point of great theoretical and practical importance." The fact that available phosphate is abundant in these Otago soils but deficient in most New Zealand soils, especially those of the North Island and northern parts of the South Island, suggests that some day Central Otago, with its splendid summer climate and irrigation possibilities, will become one of the finest farming districts in New Zealand.

The same writer points out that this amount of available phosphoric acid would probably equal a dressing of from 8 cwt. to 16 cwt. of phosphoric acid per acre, which would take from 2½ tons to 5 tons of superphosphate to supply. If the computation is correct, then the marvellous results obtained from this soil are explained.

The following table (adapted from Mr. Aston's article) gives some analyses of Central Otago mica-schist soils made in the Department's Chemical Laboratory from time to time:—

Table 1.—*Chemical Analyses of Central Otago Micaceous Soils.*

Laboratory No.	Locality.	Vol tile Matter.		Total Nitrogen.	1-per-cent Citric-acid Extract, Dyer's Method, Hall's Modification (Available Plant-food).				Hydrochloric-acid Extract (Total Plant-food).			
		At 100° C.	On Ignition.		Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .
L 295	Earnsclough ..	2.48	4.60	0.140	..	..	0.014	0.052	0.35	0.38	0.20	0.10
R 944	Cromwell ..	0.64	0.34	0.080	..	..	0.011	0.069	0.47	1.01	0.16	0.24
J 11	Alexandra ..	32.00	1.12	0.056	..	..	0.008	0.064	..	..	..	..
P 77	Maniototo ..	4.52	5.95	0.189	..	..	0.031	0.041	..	..	..	..
P 278	Composite sample	1.92	6.05	0.254	0.197	0.055	0.037	0.031	1.23	1.02	0.66	0.09

The composite sample was made up of samples of soils from Roxburgh (two), Beaumont, Naseby, Sutton, Manuhierikia, Maniototo, St. Bathans, and Frankton. This analysis supports the statement of Professor Park in Bulletin No. 2 of the Geographical Survey, that "the soil possesses a latent richness that the casual observer would hardly suspect. By the application of water the wilderness is transformed into fruitful gardens and prosperous farms. The conservation and distribution of water for irrigation purposes will in time convert the plains and valleys of Central Otago into one of the most prosperous agricultural districts in New Zealand."

While it is true that a large percentage of the soil is of first-class quality, it must be borne in mind that, like most districts, a diversity of soils exists. Thus in Ida Valley the character of the subsoil is quite different from that obtaining in the Manuhierikia Valley, in that the former is of a close clay texture and the latter of a free open nature

largely intermixed with waterworn gravel. Again, cropping out from deep deposits of schist soil appear large beds of lighter gravel, in character so porous as to make the application of water to them, while in their natural state, a difficult and wasteful matter. As will be shown later, there is a very intimate relationship between these different types of soils and the methods required to irrigate them.

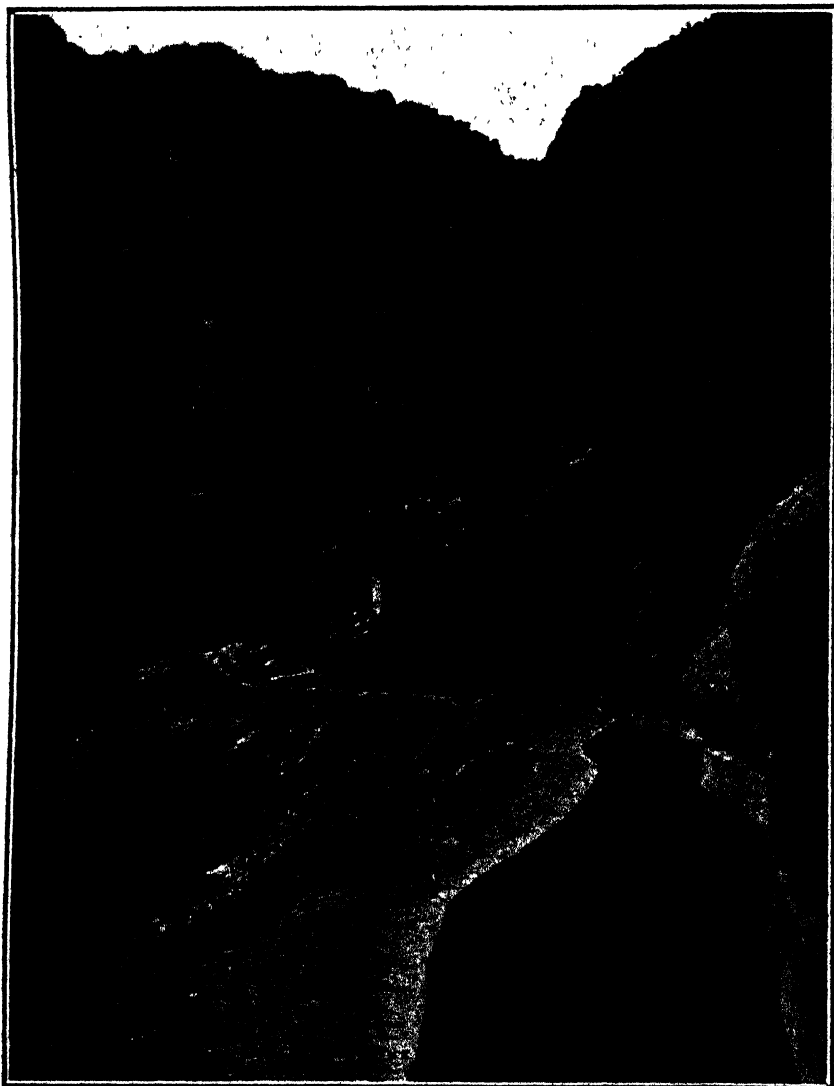


FIG. 5. GORGE, SHOWING MICA-SCHIST FORMATION.

The water-race seen is part of the main race of the Government Manuherikiu scheme.

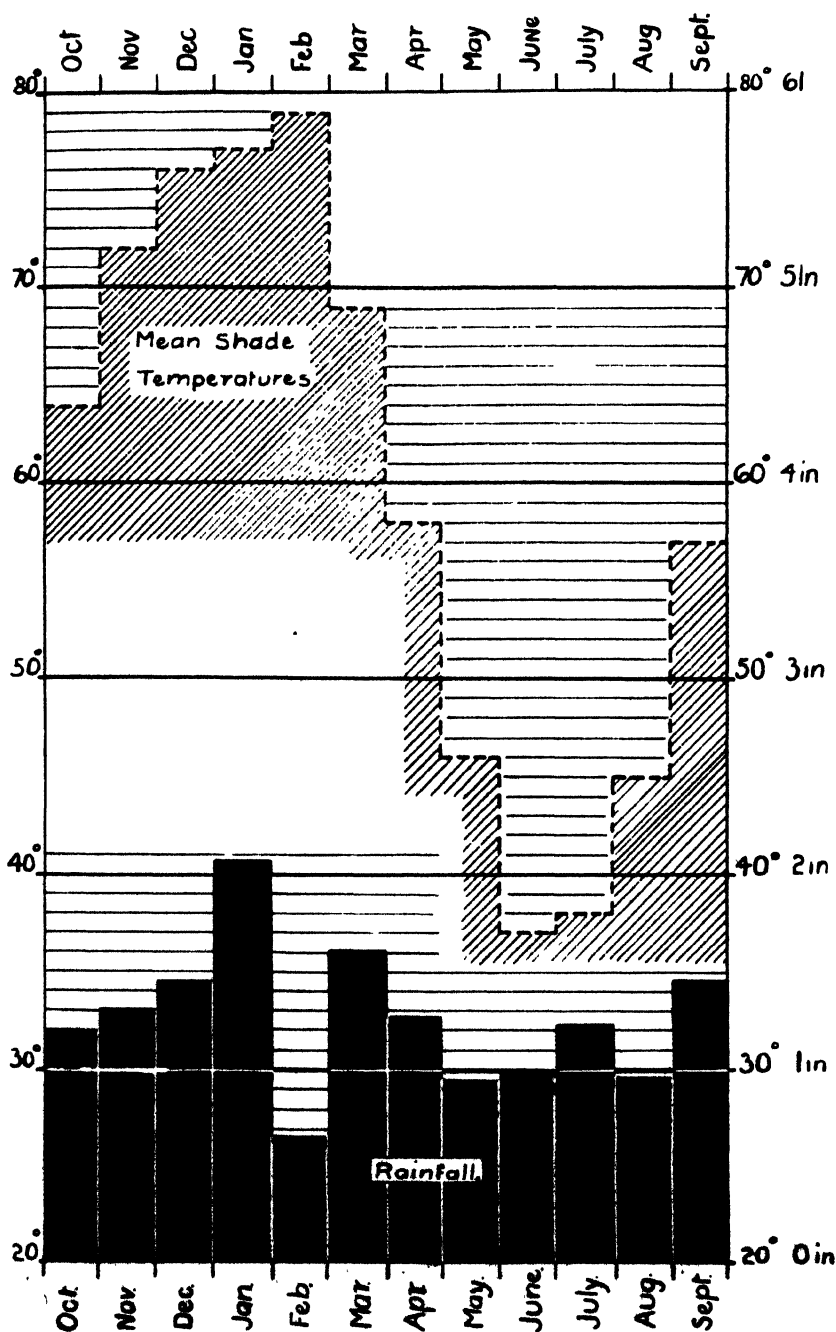


FIG. 6. GRAPH SHOWING MEAN MONTHLY SHADE-TEMPERATURE (FAHR.) AND AVERAGE MONTHLY RAINFALL FOR CENTRAL OTAGO IRRIGABLE REGION. Temperature from two years' and rainfall from five and a half years' records.

Rainfall.

When it is borne in mind that the average rainfall over the South Island is in the vicinity of 45 in. per annum, then it will be realized that Central Otago, with an annual fall averaging slightly over 15 in. and ranging from 12 in. to 20 in. per annum, is in a most unfavourable situation insofar as rainfall is concerned. Fig. 6 illustrates in graphical form the average monthly rainfall and temperature of the irrigable lands, and demonstrates the necessity of augmenting this low summer rainfall. From this graph it will be observed that the average rainfall during the growing-period—October to March inclusive—is approximately 8.8 in., and that during the month of February the average rainfall is the lowest for the year, being approximately $\frac{3}{4}$ in. During that month, however, the highest temperatures throughout the year are recorded, and when it is borne in mind that the mean shade temperature for the whole month is 79° F. it will be understood how excessive is the heat, and consequently how great must be the evaporation of moisture from the soil. During February, therefore, more frequent irrigations must be given to growing crops.

GOVERNMENT IRRIGATION SCHEMES COMPLETED OR UNDER CONSTRUCTION.

Brief details of the Government schemes completed or under course of construction in Central Otago will be of use, and the information is given in tabulated form in the accompanying Table 2.

In the case of the Ida Valley scheme, the area is admirably adapted for dairy-farming and the raising of beef or mutton (Fig. 7). The growing of special seed crops such as clover, &c., would appear to offer good remuneration to the farmers there. On account of its height above sea-level—namely, 1,500 ft.—the conditions are not favourable for fruit-growing except in some sheltered spots. General mixed farming, and especially lucerne-growing, present great possibilities. As regards the other irrigation areas mentioned in Table 2, practically any type of farming can be successfully practised on them, but there is no doubt that intense cultivation combined with either dairy-farming, the raising of stock, or fruitgrowing will give the most satisfactory results.

In addition to the schemes already in hand the Government has also investigated an extensive tract of country in order to ascertain the feasibility or otherwise of irrigating further areas of land. As a result of such investigations it is now realized that a much greater extent of country can readily be utilized for irrigation, as shown in Table 3.

Even with the inclusion of the projects detailed in Table 3 the possibilities of irrigating further tracts of country are by no means exhausted. The district abounds in potential hydro-electric power projects capable of developing immense amounts of power, and when the industries of the Dominion warrant the harnessing of one or more of these there are very great possibilities for the use of their surplus energy for pumping irrigation water during the periods of the twenty-four hours when the demand for other purposes is low. By thus working to the convenience of the usual power-requirements of other industries it should be possible to apply power to irrigation pumping

Table 2.—Government Irrigation Schemes completed or under Construction.

Name of Scheme	Source of Water-supply	Minimum Natural Flow of River	Main Canal: Maximum Capacity	Average Annual Rainfall.	Gross Area included	Area now being irrigated	Remarks.
Ida Valley	Manorburn, Poolburn, and other small streams	Cusecs (Practically no natural flow in summer. Supplied from winter water conserved in Manorburn Dam)	Cusecs 100	Inches 15.30	Acres. 28,000	Acres 12,000	Further conservation dams to be constructed to fully supply whole area
Galloway	Ditto		15	13.77	1,300	900	Completed.
Obrig Terrace	"		10	13.77	1,000	500	Completed.
Manuherikia No. 1	Manuherikia River		100	11.22	11,000	3,500	Completed.
Ardgour	Lindis River	77 50 (estimated)	20	21.75	2,000	2,000	Completed.
Tarras	Lindis River	50 (estimated).	70	21.75	7,000	100	Under construction
Earnsclough	Fraser River	8	20	15.86	4,000	1,100	Conservation dam may be necessary. Partially completed.
Last Chance	Shingle, Gorge, and Coal Creeks	11	20	17.87	4,300	700	Conservation dam will be eventually required
							Under construction. Available water only sufficient for full irrigation of 2,000 acres and partial irrigation of balance.
Teviot River	Teviot River and Lake Onslow Dam	40 (estimated)	80	21.97	3,000	300	Under construction.
Bengerburn	Bengerburn Creek	..	5	21.97	1,000	..	Under construction
Totals	..	..	..	..	63,800	21,400	

Table 3.—Further Government Schemes investigated.

Name of Scheme.	Source of Water-supply.	Minimum Natural Flow of River.	Average Annual Rainfall.	Area approximately irrigable.	Remarks.
Cromwell Flat and Lowburn	Roaring Meg Stream	Cusecs.* 29	In. 21.75	Acres. 3,750	Also presents possibilities for hydro-electric power development with water before use for irrigation.
Upper Manuherikia	Manuherikia and Dunstan Rivers	77	17.59	100,000	Two or three large storage dams will be necessary.
Maniototo	Taieri River	25	18.34	150,000	A large storage dam will require building.
Teviot River extension	Teviot River and Lake Onslow Dam	40	21.07	13,400	Lake Onslow Dam will require enlarging.
Arrow River	Arrow River	100 (estimated)	32.18	6,500	Gravity scheme.
Chapman's Gully	Butcher's Creek and Storage Dam	..	14.91	100	Gravity scheme.
Bendigo Flats	Lindis River	50	21.75	3,000	Gravity scheme.
Hawea Flats, first development	Timaru Creek	20 (estimated)	24.95	4,000	Gravity scheme.
Total	..	..	..	280,750	

* The term "Cusec" denotes a flow of water equivalent to 1 cubic foot per second. It is synonymous with the old mining term a "head" of water.

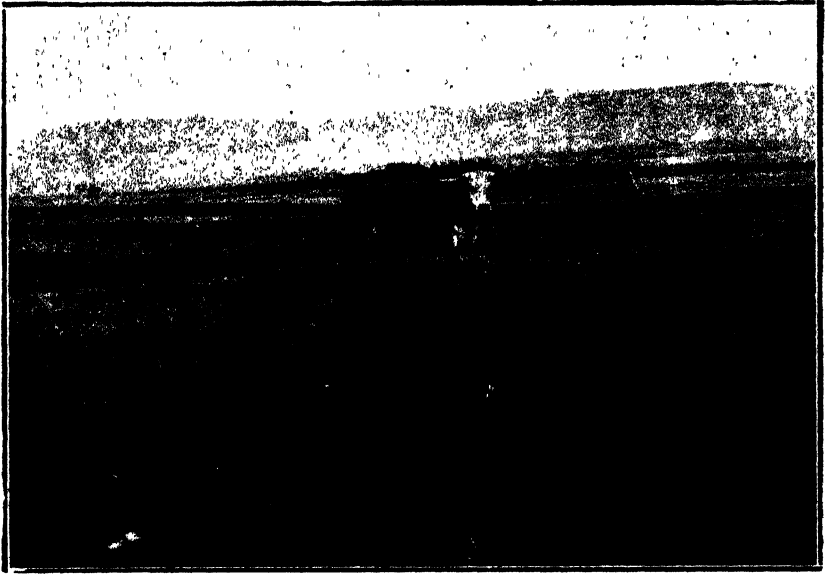


FIG. 7 VIEW IN IDA VALLEY.

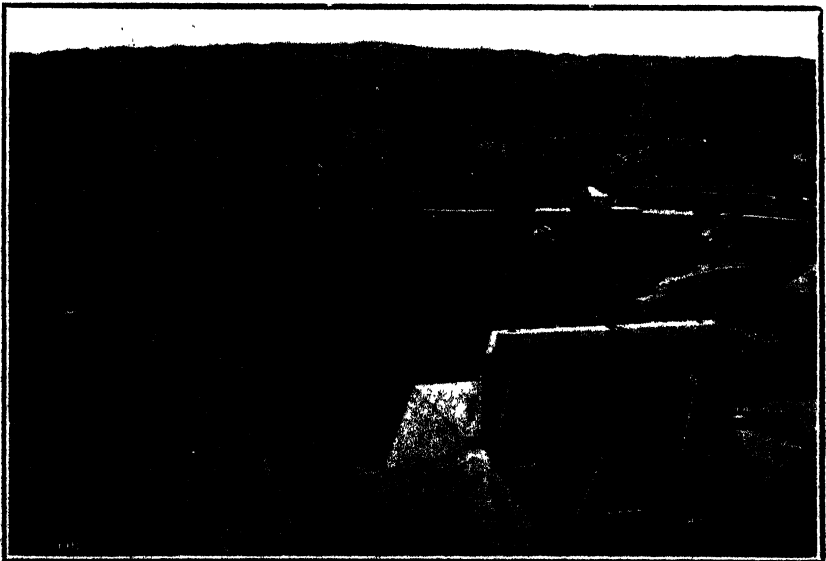


FIG. 8. SIPHONS AT CHATTO CREEK: A FEATURE IN THE MANUHERIKIA SCHEME.

Note pipe-lines carrying water across flat and over hill on other side.

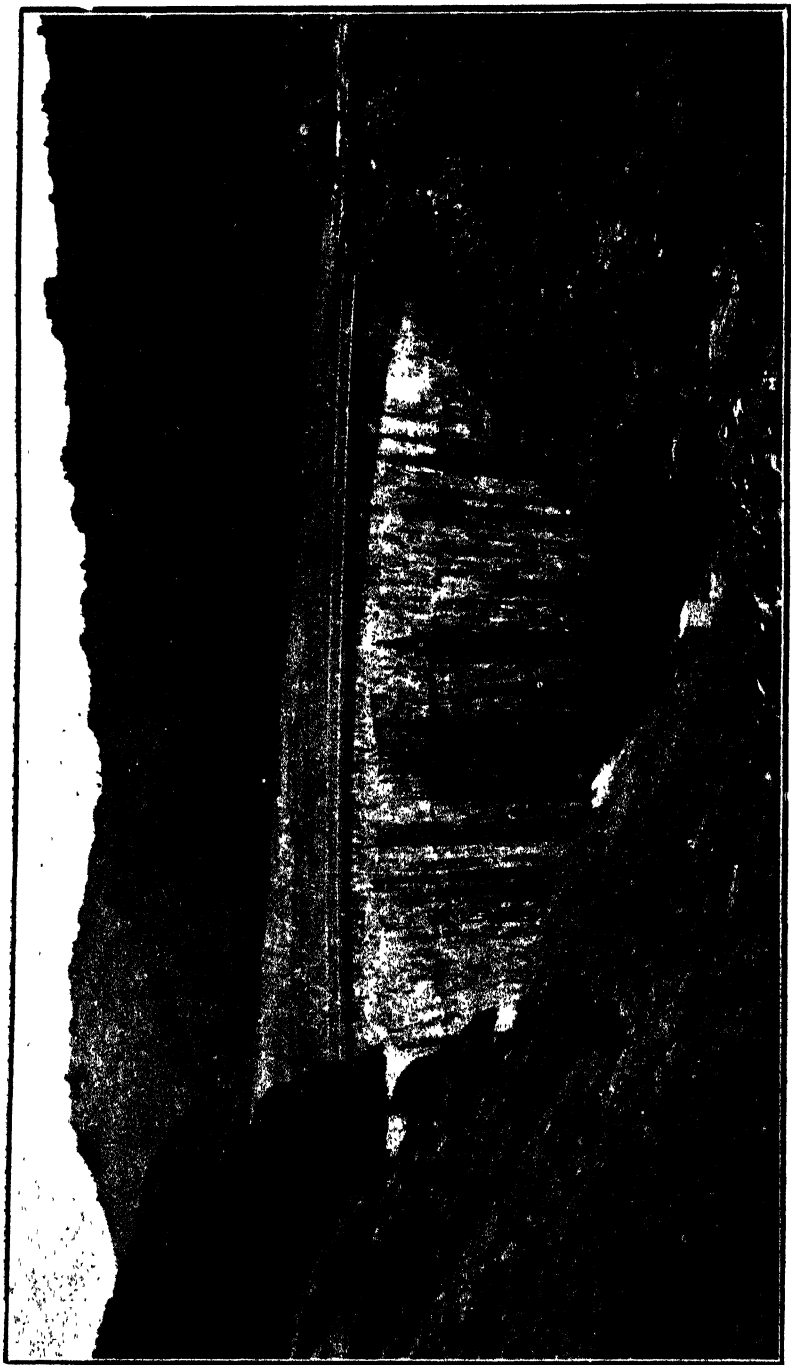


FIG. 9. THE MANORBURN DAM: IDA VALLEY SCHEME.

at low cost, while at the same time probably justifying the undertaking of such power schemes at an earlier date than might otherwise appear warranted. With cheap hydro-electric power there is no doubt that many areas not now being investigated as potential irrigation settlements, chiefly because an economic gravitational supply of water is not available, would be dealt with by pumping water from the larger rivers and lakes.

INDIVIDUAL, COMPANY, AND LOCAL-BODY UNDERTAKINGS.

Irrigation development has also been successfully carried out, or is at present in progress through individual effort, by companies, or by local bodies. Works undertaken by individual effort comprise a hundred or more small areas scattered throughout the district, generally in the most favourable situations, which involve a minimum of construction cost. There are, however, a few instances where more enterprising settlers have confidently and successfully constructed irrigation works of considerable magnitude, involving in some instances the loading of their farms with construction costs running into several thousands of pounds. Among the most notable of these individual irrigation undertakings are those of Mr. John Wilson, at Lauder; Mr. P. R. Sargood, at Wanaka; Mr. Lee, at Lake Hayes; Mr. Lethbridge, at Ardour; and Mr. R. K. Smith, at Tarras. The last-mentioned undertaking has recently been acquired by the Crown for enlargement and extension. The total area of lands under irrigation by individual effort is estimated by the writers at 10,000 acres.

There are only two instances of companies being formed to construct irrigation works—namely, the Little Valley development party and the Cromwell Development Company. The former have acquired

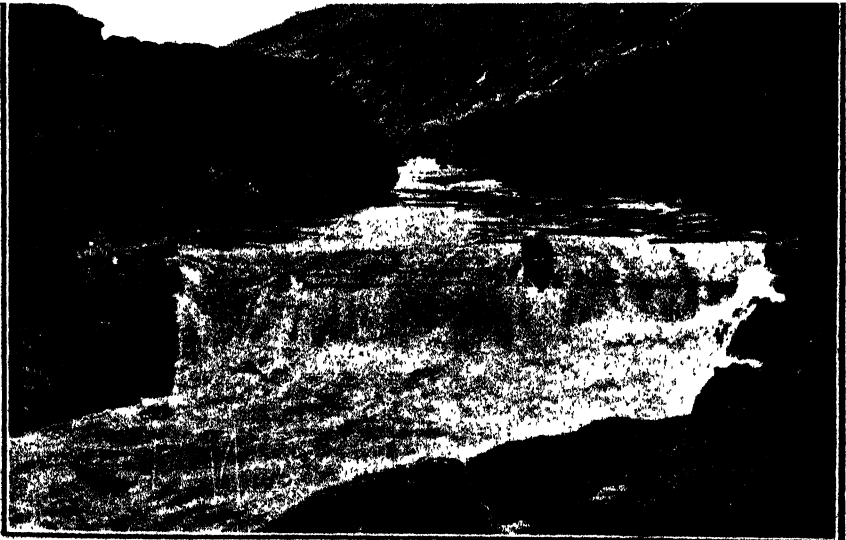


FIG. 10. KAWARAU RIVER, SHOWING CROMWELL DEVELOPMENT COMPANY'S WEIR.

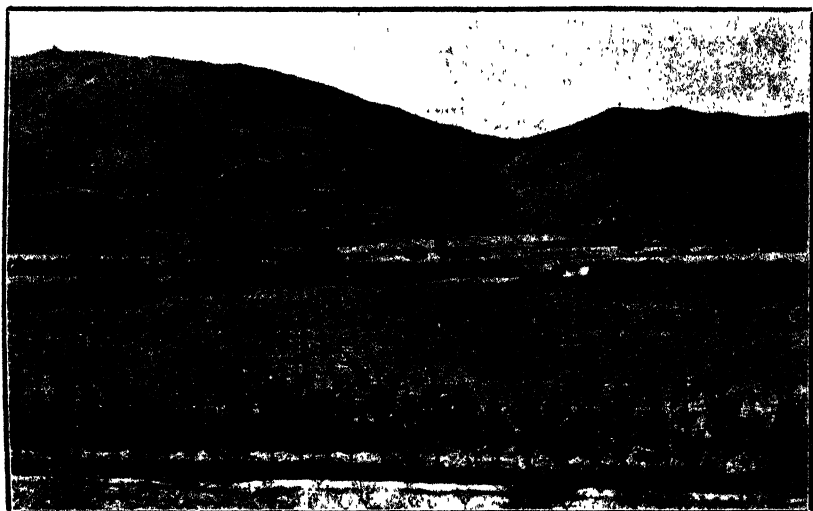


FIG. 11. THE CROMWELL DEVELOPMENT COMPANY'S RIPPONVALE SETTLEMENT.

abandoned mining water-races and are developing them with a view to irrigating 1,000 acres of land. The Cromwell Development Company has undertaken and practically completed works of very considerable magnitude and of a most interesting nature which will provide irrigation for probably 4,000 acres or more (Figs. 10 and 11).

There are three local-body schemes, all under the Vincent County Council—namely, Bannockburn (about 1,700 acres), Matakauri (about 5,000 acres), and Blackman's (about 1,000 acres). The two former are in a state of development, only about half of the areas being yet supplied with water, while the last-named has been in full operation for many years.

SUMMARY OF IRRIGABLE AREAS.

The following table gives a summary of all the areas in Central Otago capable of irrigation by gravitation and pumping methods.

Table 4.—Summary of all Irrigable Areas.

—	Area actually under Irrigation at 30th January, 1924.	Works under Construction—mostly expected to be completed during 1924.	Areas investigated and considered Feasible for Development by Gravitational Water-supply.	Further Areas estimated as probably irrigable when Cheap Power available for Pumping.	Totals.
	Acres.	Acres.	Acres.	Acres.	Acres.
Government	21,400	42,400	280,750	42,350	386,900
Individual	10,000	..	..	..	10,000
Company ..	..	5,000	..	..	5,000
Local body	4,350	3,350	..	..	7,700
Totals	35,750	50,750	280,750	42,350	409,600

(To be continued.)

INTRODUCTION OF SHEEP INTO NEW ZEALAND.

RECORD OF FIRST ENTRY OF EACH BREED.

J. G. COOK, Live-stock Division, Wellington.

It is generally admitted that insufficient attention has been given in the past to the compiling of records of different matters connected with the earlier history of British settlement in New Zealand. Among such matters may be included that of the introduction of live-stock.

The information tabulated below represents an endeavour to supply the deficiency as regards the first introduction of various sheep-breeds into this country. Although the compilation is the result of considerable research it is not as complete in detail as could be wished, and the writer will welcome any information enabling missing particulars to be filled in. Needless to say, it is highly desirable that complete and authentic records, covering this and related matters in the agricultural history of the Dominion, should be held by the Department of Agriculture.

It may be mentioned that several of the breeds represented in the list have not been maintained in New Zealand since their introduction. So far as can be ascertained the following breeds have been dropped: Dartmoor, Roscommon, Scotch Blackface, Norfolk Down, Cotswold, Tunis, and Bharal. Several other breeds—namely, Dorset Horn, Hampshire Down, Oxford Down, South Devon, and Wensleydale—are present in very small numbers only.

FIRST INTRODUCTIONS OF SHEEP-BREEDS INTO NEW ZEALAND.

Breed.	Date of Arrival.	Animals.	Introduced by	Province.	Breeder.	Introduced from
Merino	18th-22nd May, 1773 (ship "Resolution")	1 ram, 1 ewe	Capt. James Cook	Marlborough	..	Cape Colony.
"	23rd Dec., 1814 (ship "Active")	..	Rev. S. Marsden	Auckland	Rev. S. Marsden	New South Wales.
"	4th May, 1842 (ship "Jupiter")	..	Capt. W. King	Taranaki	..	New South Wales.
Southdown	23rd Feb., 1842 (ship "Timandra")	2 rams, 10 ewes	Mr. Devenish	Taranaki	Mr. Briscoe..	Dorset.
English Leicester	28th Sept., 1843 (ship "Tyne")	1 ram ..	A. Saunders	Nelson	J. Arnold ..	Somerset.
Cheviot	26th Jan., 1845 (ship "Slains Castle")	1 ram, 1 ewe	Mr. Mackay	Nelson	..	..
Romney Marsh	2nd Sept., 1853 (ship "Cornwall")	4 rams, 16 ewes	L. Young ..	Wellington	Jeremiah Solomon	Northfleet, Kent.

FIRST INTRODUCTIONS OF SHEEP-BREEDS—*continued.*

Breed.	Date of Arrival.	Animals.	* Introduced by	Province.	Breeder.	Introduced from
Border Leicester	1859 (ship "Cheviot")	1 ram, 9 ewes	New Zealand and Australian Land Company	Otago ..	1 ram and 3 ewes, Mr. Melvin, Bonnington; 6 ewes from Duke of Buccleuch	Dalkeith, Scotland.
Lincoln ..	1860.. ..	..	Esson Bros.	Wellington	..	Lincolnshire.
Cotswold ..	Oct., 1863 (ship "Gothenberg")	4 rams ..	..	Canterbury	..	..
Hampshire Down	Oct., 1863 (ship "Gothenberg")	5 rams ..	..	Canterbury	..	..
Dartmoor* ..	5th June, 1864	5 rams, 6 ewes	C. Reid ..	Canterbury	..	Devonshire.
Shropshire Down	1867.. ..	1 ram, 3 ewes	C. Williams..	Canterbury	..	England.
Norfolk Down ..	1868.. ..	..	W. Wilson ..	Canterbury	..	..
Alpaca* ..	9th Nov., 1872	1 ram, 1 ewe	R. H. Rhodes	Canterbury	..	..
Wensleydale ..	4th April, 1894	1 ram, 2 ewes	W. B. Clarkson	Canterbury	1 ram, Mr. Hodgen; 2 ewes, W. Trotter	Yorkshire.
Dorset Horn ..	25th Oct., 1897	1 ram, 2 ewes	W. Ulyett ..	Canterbury	..	..
Kent ..	25th Oct., 1897	2 rams ..	J. B. Logan	..	..	Kent.
Tunis* ..	24th Oct., 1900	2 rams, 6 ewes	H. Harrowell	Auckland ..	..	Tunis.
Ryeland ..	6th May, 1901	2 rams ..	Dalgety and Co.	Canterbury	..	Herefordshire.
„ ..	30th Dec., 1901	2 rams, 5 ewes	W. P. Kellock	Canterbury	..	Herefordshire.
Oxford Down ..	July, 1904 ..	1 ram, 5 ewes	J. Withell ..	Canterbury	Ram, F. Bonner Barling; ewes, C. Watkins	Herefordshire.
Roscommon* ..	1904.. ..	4 rams, 10 ewes	J. Davies ..	Wellington	Various ..	Ireland.
South Devon ..	5th Dec., 1907	1 ram, 16 ewes	W. J. Birch..	Wellington	W. Tippet and E. Stokes	Devonshire.
„ ..	1907.. ..	1 ram, 12 ewes	Chambers Bros.	Hawke's Bay	Various ..	Ditto.
Bharal* ..	30th July, 1908	2 rams, 2 ewes	N.Z. Tourist Department	Finally liberated in Canterbury	Mr. Jamrach	Kuin Lun Mountains (Himalaya), Tibet.

* Only importation of this breed.

FIRST INTRODUCTIONS OF SHEEP-BREEDS—*continued*.

Breed.	Date of Arrival.	Animals.	Introduced by	Province.	Breeder.	Introduced from
Scotch Blackface*	19th Aug., 1908	2 rams, 4 ewes	Mrs. Townsend	..	..	..
Suffolk Down ..	23rd Dec., 1913	1 ram, 6 ewes	G. Gould ..	Canterbury	1 ram and 2 ewes, S. R. Sherwood; 4 ewes, Chivers and Sons	England.
Dorset Down ..	7th Nov., 1921	2 rams, 5 ewes	J. C. N. Grigg	Canterbury	I. R. Spillet	Dorset.

* Only importation of this breed.

THE MEALY-BUG PEST IN ORCHARDS.

CONTROL BY CRYPTOLAEMUS LADYBIRD.

DAVID MILLER, Entomologist, Biological Laboratory, Wellington.

THE matter of the control of mealy bugs in orchards in certain parts of New Zealand has been attracting considerable attention among those interested. Owing to the nature of the insect and its habit of frequenting out-of-the-way places such as bud-scales, beneath bark, in crevices, in the calyx and stalk end of fruit, &c., present spraying methods are not an effective means of control. Control by beneficial insects has therefore been looked to as a possible means of overcoming the difficulty, and the work of establishing in New Zealand the ladybird beetle *Cryptolaemus montrouzieri* Muls. has been put under way for this purpose.

The female mealy bug is wingless, and characterized by a white mealy covering, though the insect itself is pinkish in colour. Further, the body is fringed with short leg-like appendages, the end ones in some species being long and tail-like. These appendages have nothing to do with locomotion, the three pairs of legs being situated on the under-side just behind the head. The insect moves about fairly rapidly from one part of a host-plant to another, and where it settles punctures the tissues and sucks up the sap through its proboscis. The male insect at an early stage becomes different from the female: it constructs a narrow white cocoon in some out-of-the-way place and there transforms, losing its mouth-parts but developing a pair of wings and a pair of long tail-like appendages. When egg-laying commences the mature female constructs a woolly egg-sac, in the meshes of which the small yellowish eggs are entangled. When all the eggs have been deposited the sac may be larger than the parent itself. It frequently happens that the female will leave the host-plant in order to lay her eggs, and in consequence the egg-masses may occur in any convenient and sheltered crevice.

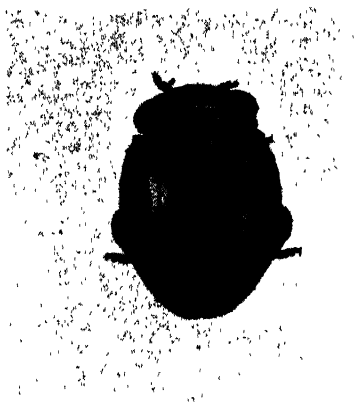


FIG 1 CRYPTOLAEMUS MONTROUZIERI LADYBIRD BEETLE. MAGNIFIED 7 DIAMETERS.

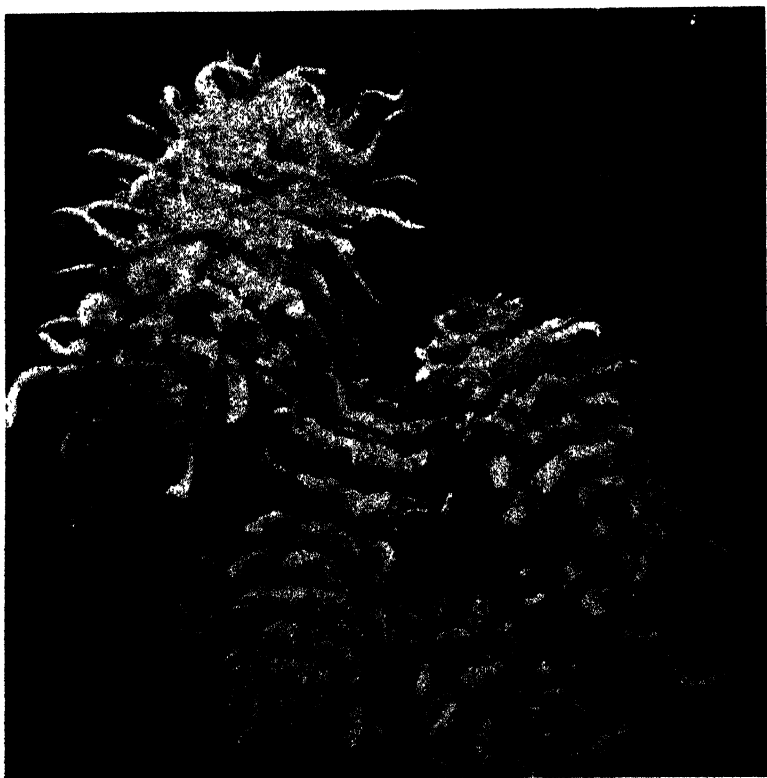


FIG 2. LARVÆ OF C. MONTROUZIERI. MAGNIFIED 7 DIAMETERS.

At this stage the parasite feeds on the mealy bug.

[Photos by H. Drake.]

There are several species of mealy bugs in New Zealand. Two—Baker's mealy bug (*Pseudococcus maritimus* Erh.) and Comstock's mealy bug (*P. comstocki* Kuw.)—are commonly found, but the host-plants are varied.

The ladybird *Cryptolaemus montrouzieri* is a native of Australia, and has been imported into California and other countries for the purpose of combating mealy bugs. The beetle itself measures about $\frac{1}{8}$ in. long (Fig. 1) and is easily recognized by its colour-pattern, both ends of the blackish body being orange-yellow. The eggs are laid in the egg-masses of the mealy bug; from two to three weeks later the beetle-larvæ hatch, and feed on the mealy bugs. These larvæ are very like the female mealy bug in general appearance, being white and having numerous leg-like appendages projecting from the body (Fig. 2). The larva becomes fully grown in about four or five weeks and seeks out some convenient crevice, where it transforms to the pupa, retaining the old larval skin as a covering. About a fortnight later the beetle emerges. The period taken to develop from egg to adult varies with conditions of temperature and moisture, the mealy bug, also, being similarly affected.

As early as 1897 an attempt was made by the Department of Agriculture to establish this ladybird in New Zealand, numbers having been liberated in the North Island, particularly in the Auckland District. For a time no good results were noticed, but in 1901 it was reported that mealy bugs—except in glasshouses—were under control. The reports on this attempt to introduce the ladybird are, however, of too meagre a nature to base any conclusions upon. Of recent years the beetle has become uncommon in the North Island. It was introduced into Canterbury shortly after 1900 to combat the gum-tree scale, but did not survive.

Last August a consignment of the ladybirds was received from Mr. W. B. Gurney, Government Entomologist, New South Wales, and from this lot a colony was started at the Biological Laboratory. A second consignment arrived during December, so that sufficient material became available for distribution in small quantities. A third consignment including two other species of mealy bug natural enemies (*Scymnus binaevatus* and *Leptomastix abnormis*), which arrived at this Laboratory on 16th February, was sent from California through the kindness of Professor H. S. Smith and Dr. H. M. Armitage.

The method of rearing the ladybirds here is much the same as that adopted by the California Department of Agriculture, at Sacramento. Mealy bugs are bred upon sprouted potatoes, and small shallow boxes containing the latter, heavily infested, are placed in the breeding-cages with the ladybirds. As soon as adults emerge from pupæ they are transferred to a separate cage and another brood started.

Threshing-machines.—When threshing or chaff-cutting it is important to stipulate that the machine shall be thoroughly cleaned of all weed-seeds before it comes on to the farm. Weed-infected screenings should be burnt before there is a chance of their being spread.

THE RELATION OF BIRDS TO AGRICULTURE IN NEW ZEALAND.

VIII. THE PIGEON, KIWIS, RAILS, AND SHORE-BIRDS.

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THE PIGEON.

THAT family of the order of pigeons which includes the fruit-pigeons contains no more beautiful birds, even among its numerous tropical members, than the New Zealand pigeon, sometimes known by its onomatopœic name of "kuku" or "kereru." No description of its magnificent plumage, with the coppery purple of the back and the metallic green of the breast set off by the pure-white underparts, nor of the unmistakable clap-trap of its wings in flight should be necessary to New Zealand readers, although it is too true that there are large areas, even of bush country, where owing to the inroad of shooters and of weasels the pigeon is no more to be seen. Sufficient was said in the second article of this series to indicate the high value of berry-eating birds and of the pigeon in particular in the economy of the indigenous forests. For a detailed description of the food of the pigeon at various seasons of the year Buller's account, drawn up from ample experience in the days when this bird had not yet begun to decrease, is hardly to be improved on. We quote it here to indicate the large number of forest species with which the pigeon enters into food relations :—

"In the spring and early summer it is generally very lean and unfit for the table; but as autumn advances and its favourite berries ripen it rapidly improves in condition, till it becomes exceedingly fat. It is esteemed most by amateurs when feeding on the mast of the miro (*Podocarpus ferrugineus*), which imparts a peculiar richness to the flesh. In January the berries of the kohutuhutu (*Fuchsia excorticata*), poroporo (*Solanum aviculare*), kaiwiria (*Hedycarya arborea*), puriri (*Vitex lucens*), mangeao (*Litsaea calicaris*), and tupakihi (*Coriaria ruscifolia*) constitute its ordinary bill of fare. From February to April their place is supplied by those of the tawa (*Beilschmiedia tawa*), matai (*Podocarpus spicatus*), kahikatea (*Podocarpus dacrydiodes*), mapau (*Rapanea Urvillei*), titoki (*Alectryon excelsum*), and maire (*Olea* spp.). It is worth remarking that in localities where it happens to be feeding exclusively on the pulpy fruit of the kahikatea it is not only in very poor condition, but acquires a disagreeable flavour from the turpentine contained in the seeds. Towards the close of this period, also, the ti-palm (*Cordyline australis*), which comes into full bearing only at intervals of three or four years, occasionally supplies this bird with an abundant feast. In May and June it feeds chiefly on the miro and pate (*Schefflera digitata*), when it reaches its prime and is much sought after. From July to September it lives almost entirely on taraire

(*Beilschmiedia taraire*) in the North, and on hinau (*Elaeocarpus dentatus*), koeka (*Pseudopanax crassifolium*), ramarama (*Myrtus bullata*), and other smaller berries in the South. During the months of October, November, and December it is compelled to subsist in a great measure upon the green leaves of the kowhai (*Sophora tetraptera*) and of several creeping plants. It also feeds on the tender shoots of the puwha (*Sonchus oleraceus*), a kind of sow-thistle, and the flesh then partakes of the bitterness of that plant. When the bird is feeding wholly on the dark berries of the waowao the colour of its flesh is said to become affected by that of the food. The pigeon season, however, is to some extent contingent on locality; for example, in the spring of 1863 I found these birds in the upper Manawatu living on kowhai-leaves, and so lean in body as to be scarcely worth powder and shot, while in the low-timbered flats under the ranges, where they were feeding on the ripe berries of the karaka (*Corynocarpus laenigata*), they were in excellent condition."

In the above passage the botanical names of the plants mentioned have been inserted, for convenience of references, by the present writers.* The list of berries is a large one, and may be further increased by the addition of houhou (*Nothopanax arboreum*), karamu (*Coprosma robusta* and *C. lucida*), and sweetbrier (*Rosa eglanteria*).

Data are lacking as to the proportion of actual viable seed which is passed by the pigeon in eating these various berries. Only the patient observation of years can bridge this hiatus in our knowledge. Although the bulk of the pigeon's food is secured from the forest, which forms its chief haunt, it occasionally makes a sally into cleared country. On such occasions the writers have seen it eating shoots of broom (*Sarothamnus scoparius*), while Guthrie-Smith states: "They also freely feed on white-clover leaves; on fallen forest, newly sown, I have known them grow excessively fat on rape and turnip shaws." The pigeon is deservedly absolutely protected.

THE KIWIS (APTERYX SPP.).

There are in the world no more remarkable birds than the kiwis of New Zealand. They are altogether anomalous. For long the systematic ornithologist saw in them affinities with that primitive group of birds which includes the ostrich, the emu, and their relatives; but the trend of modern research, both anatomical and parasitological, is to place them nearer the rail order.

Three species of kiwi, with several races, all confined to New Zealand, are now recognized. If ever birds should be protected solely on account of scientific uniqueness the kiwis deserve that honour; yet they are in considerable danger of extermination by dogs and weasels, to which their total flightlessness has made them an easy prey.

There is probably a strong element of novelty about the suggestion that the kiwi deserves well on any other ground than pure scientific interest. The economic side of the question, especially in view of the popular belief that kiwis live almost entirely on worms, will be found

* We are indebted to Mr. Elsdon Best for the exact identification of several of Buller's plant-names. Two, however—"waowao" and "whao"—are not known to Mr. Best.

full of surprises. We have indicated previously, in the second article of this series (*Journal*, May, 1923), the 'highly useful role played by the kiwi as a member of the bird police force of the forest-floor—that nursery of silvan insect-life. In this sphere the kiwi is second in efficiency and utility only to the weka, a bird which has not the kiwi's clean reputation—with regard to eggs, for example. The kiwi functions firstly as a destroyer of injurious insects, grubs of borer-beetles, and other insects, and secondly as an eater (and probably therefore a dispersing agent) of the fruit of various trees, such fruit being, of course, necessarily picked up from the ground, except when borne on low shrubs.

Buller found the stomach of a single North Island kiwi to contain the following assortment: Three large wetas, ten huhus (these are the larvæ of our largest beetle, a most destructive borer, *Prionoplus reticularis* White), a large longicorn boring-beetle (*Coptomma*), several earthworms, a large earthworm egg-cocoon, and berries of maire (*Olea* spp.) and of taiko (*Fusanus Cunninghamii*). The stomach of a second contained unrecognizable insect-remains, minute land-shells, and the hard kernel of taiko-berries, which Buller suggested were used instead of pebbles for triturating the food. Other kiwis opened had eaten the berries of pokaka (*Elaeocarpus Hookerianus*), miro, maire, and hinau.

In connection with the kiwis, one last point needs further stressing. The belief is still prevalent in North Auckland that the North Island kiwi (*Apteryx australis mantelli* Bartlett) carries cattle-ticks. Undoubtedly specimens of these birds have been caught infested with ticks; and ticks generally are somewhat similar. The writers have, however, seen hundreds of ticks from kiwis, and in no single case was the cattle-tick (*Haemaphysalis bispinosa* Neum.) present; all were specimens of the kiwi-tick (*Ixodes* sp.), which never in any circumstances attacks stock of any description.

THE RAILS (RALLIFORMES).

Passing over the now uncommon dabchick or little grebe (*Poliiocephalus rufopectus* Gray), the food of which, according to Buller, consists of small mollusca (including probably the fresh-water snail which acts as a host of the liver-fluke), and leaving its rare and beautiful cousin the crested grebe (*Podiceps cristatus* L.), which is likewise too scarce to be of much economic importance, we come to the large and widespread group of rails. These birds include many highly interesting and insectivorous forms, the smaller of which are so retiring in their habits as to be rarely seen, although much commoner than is usually supposed. Thirteen species have been recorded from the New Zealand region, but several are either rare visitors or stragglers or else confined to the outlying islands, so that there are only seven which are sufficiently numerous to be of any economic importance. These will be dealt with in turn.

The Pukeko (Porphyrio melanotus (Temm.)).

This handsome bird follows the rule formulated in another publication by one of the present writers that if we take two related species of New Zealand indigenous birds the one which is the least related to foreign birds will be the rarer. Thus the birds which have suffered

most from the adverse influence which our civilization has consciously or unconsciously brought upon them are those which are most peculiarly New Zealand's own. In the present case the pukeko is an abundant species over large portions of the country, while its interesting relative, the takahe (*Notornis hochstetteri* Meyer), is one of the rarest birds in the world.

The pukeko, pukaki, or swamp-hen, with its magnificent blue breast, red beak, forehead, and legs, and black back, is familiar not only to many New-Zealanders but also to dwellers in Australia, where it is known as the "red-bill," a term applied in this country to a totally different bird—the oyster-catcher (*Haematopus* spp.).

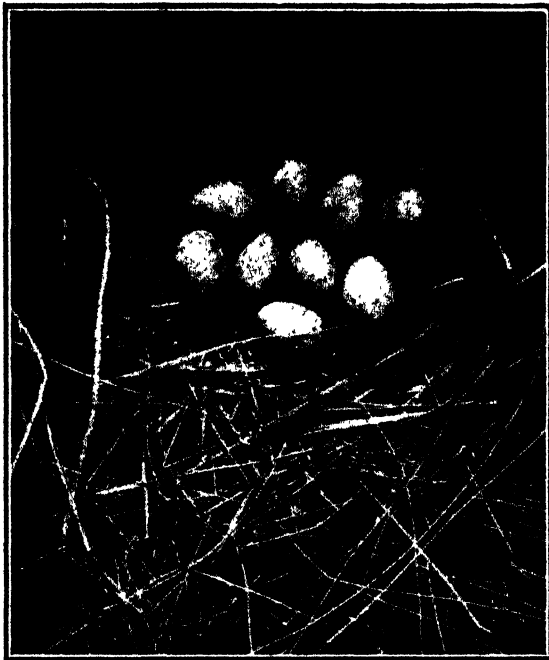


FIG. 1. NEST AND EGGS OF PUKEKO.

[Photo by T. Cockcroft.]

The nest is built on a niggerhead (*Carex secta*) or similar situation, usually in a swampy locality, and may contain a considerable number of eggs not all laid by the same female.

In Australia Cleland and his co-workers found the stomach-contents to consist of vegetable matter, presumably not further recognizable. In New Zealand the pukeko, unless present in large numbers, is a harmless or even beneficial species. Buller states that it subsists principally on soft vegetable substances, but feeds also on insects and grain. "It frequents the Maori plantations in considerable numbers and proves very destructive to the young crops, and later in the season it plunders the potato-fields and kumara-beds." But Buller noted also

that "this bird often leaves its home in the marshes to travel over the sand-dunes amongst the tauhinu bushes in quest of grasshoppers." The berry of a small *Coprosma* is also eaten.

Although formerly considered a game bird the pukeko has of recent years been protected, and probably as a consequence of this has in some districts increased allegedly to the proportions of a pest. One of the writers found these birds tame and plentiful near Whangarei, in February, 1923, and was informed that they were a great nuisance—treading down oats and eating the grain. Much of the damage is probably due to trampling rather than to actual eating of the crop. In October, 1923, a paragraph appeared in the Press, at Auckland, to the effect that "complaints which have been repeatedly made by farmers of recent years that the native swamp-bird, the pukeko, did much mischief to growing crops have culminated in the Department of Internal Affairs informing the acclimatization societies that permits might have to be granted to farmers to shoot the birds on their properties. The bird has been protected for some years, and has rapidly increased in some localities. When the matter came before the Auckland Acclimatization Society a report was received from one of the rangers that the birds picked out the young-shooted seeds from oats, wheat, and other cereal crops, and they also plucked off the thatch of stacks. Members of the council thought that the position might be met by having a general open season for the shooting of the birds in May, June, and July of each year, and it was decided to again suggest to the Department that such open season should be declared."

Guthrie-Smith, a farmer and a competent observer as well, writes "On a large run the damage the pukeko can do is trifling. Circumstances, however, alter cases; perhaps if even I myself possessed but a few acres I should feel annoyance at rape of oats, theft of straw, ravages amongst green maize, wholesale cropping of clover and grass. As man is constituted, the intelligence and high ethical standard of the pukeko may not atone for mischief even on this petty scale."

The Smaller Rails.

Three species of the smaller rails occur throughout New Zealand, but all three have suffered considerably at the hand of cats, rats, and probably other ground vermin, and are far less plentiful than they once were. Even in the localities where they are still abundant, however, they are very rarely seen unless caught and brought home by the domestic cat. The note of the landrail, or pectoral rail, or mohopereru (*Hypotaenidia philippensis* (L.)), is a piercing scream, often heard at night but not generally recognized by country dwellers. This moderate-sized species occurs in a wider assortment of localities than do either of the very small birds or crakes—the swamp-rail, or putoto (*Porzana plumbea* (Griff et Pidgeon)), and the marsh-rail, or koitareki (*Zapornia pusilla* (Pallas)), which are practically confined to swamps. All three species are purely beneficial, being almost entirely insectivorous. In the stomach of a landrail Buller found insects, seeds, and the succulent parts of various grasses. Unfortunately, the ground-frequenting habits and low nesting-places of these rails render them especially liable, as already mentioned, to the attacks of rats, weasels, and other vermin,

and their consequent decrease in the phormium swamps of the Manawatu has probably been a factor in the development of the phormium grubs (*Xanthorhoe praepectata* Walk. and *Melanchra steropastis* Meyr. into pests of importance.

The landrail was one of the species examined by Cleland and his colleagues in New South Wales, which is a portion of the range of this widely distributed bird. He states that this bird appears of some value, as grasshoppers and cutworms have been found in the stomach-contents. Needless to say, these birds are rigidly protected by law throughout the Dominion; but from the ground vermin which are their chief foes nothing is done to save them.

The Wekas (Gallirallus spp.).

The wekas, woodhens, or Maori hens, of which we have three distinct species, are large rails, which although possessing ample wings are yet incapable of flight. It is supposed that long isolation in New Zealand, with an accompanying absence of predaceous mammals or snakes, rendered flight unnecessary to the ancestors of these birds, and disuse led to atrophy. Their considerable size, coupled with their rich-brown black-streaked plumage, differing in intensity according to the species, render them easily recognizable.

The nest is built on the ground in a variety of situations. Guthrie-Smith, who has made a special study of wekas, and whom we shall therefore quote considerably, states: "The whereabouts of the weka's nest is largely determined by the food-supply of the vicinity, and in spring-time if a beast has got bogged or a fat sheep got trapped in an 'under-runner' it is quite worth searching for a nest in the neighbourhood. Even after the flesh is no longer fit to eat a great supply of maggots, beetles, and grubs, attracted by the carrion, provide for wekas an ample food-supply." Discussing further the situation of the nest he says: "One was on a dry limestone shelf sheltered by a huge projecting peak of the same rock. . . . Three other nests were built beneath ancient clumps of hill rush and sheltered with a natural thatch of many inches depth and of many years' accumulation."

Like our other flightless birds, though to a less extent than with the kakapo and the kiwis, the weka has suffered considerably from the influences of colonization. Dogs are its inveterate enemies, in the writer's experience rendering impossible the existence of wekas in settled districts, unless dense swamps or impenetrable cover such as gorse thickets are in abundance. So close are the interrelations of nature that we have here, in the case of the gorse and the wekas, an introduced plant protecting an indigenous bird from the attack of an introduced mammal.

The food of wekas will be considered in some detail, since in the opinion of all who have given the matter serious study these birds are among the most important economically of all the indigenous birds. In the discussion which follows our remarks will be confined to the common North Island, South Island, and Stewart Island species (*Gallirallus australis* Sparr. and *G. hectori* Hutton), since the black woodhen (*G. brachypterus* Lafresn.) inhabits a special locality and exploits a more or less peculiar food-supply.

The weka functions beneficially, firstly as a destroyer of vermin and insect pests, and secondly indirectly as a protector of most of the other indigenous land-birds. Its crimes lie chiefly in the direction of egg-stealing. It will eat fowls' eggs when it can get them, and, according to evidence quoted by G. M. Thomson, has been a serious obstacle to the establishment in this country of pheasants and wild geese. But W. W. Smith, quoted by Hutton and Drummond, believes that the weka should be held in more esteem, as "the mere destruction of a few eggs in or near the poultry-yard, or the disturbing of a few pheasants in reserves, may be overlooked when it is remembered that the weka renders inestimable services in destroying vermin." He goes on to show that the weka eats large numbers of the grass-grub (*Odontria* spp.), one of the worst enemies of pasture in New Zealand, and states that "they are also death to rats and mice and help in the destruction of young rabbits." Similarly, G. M. Thomson writes: "Mr. H. B. Flett states that a good many rabbits which had escaped from captivity at Waitahuna found their way to the open country and increased to a slight extent, but eventually died out completely. He attributes their extermination to the weka or Maori hen (*Ocydromus*) . . . They used to go into the holes and eat the young rabbits. I have seen a weka killing a half-grown rabbit." So, then, on clear country the weka is an enemy of those two important pests of our grasslands, the grass-grub and the rabbit. Yet it is on just such country that its numbers have been most seriously thinned.

Buller found that the weka ate large numbers of berries, worms, grasshoppers, crickets, beetles, mice, full-grown rats, and lizards.

Guthrie-Smith writes as follows regarding the food of the Stewart Island weka (*Gallirallus australis* var. *Scotti* (Grant)): "Eggs and young birds of certain species, no doubt, he takes in spring or summer, rats and mice when obtainable, but beetles, grubs and snails, slugs, and roots and berries are provided at all seasons by the forests and open lands, whilst the stony beaches of the inlets and coasts furnish shell-fish and crabs. It is when these birds are seen prowling along wet shores, dislodging stones as large as turnips in their open bills (the weka does not pull them towards him, he moves them entirely by grasp of mandibles)—it is then, or when rising to full height, he delivers with his bill a blow worthy of Porthos or Ivanhoe, or when he stands over a bone holding it down with one foot like a dog, and like a dog wrenching from it muscles, meat, and tendons, that you can believe that a weasel might fall before him."

When we come to the forest country we find the weka playing its second beneficial role, that of an efficient bird-protector, as first described by Guthrie-Smith in the lines quoted below. Guthrie-Smith and many other students of our birds believe that the black rat and the brown rat—introduced into New Zealand—are perhaps the most serious enemies of the indigenous birds, and have penetrated into haunts otherwise untouched by civilization. No nests are safe from their wholesale depredations.

"It is to such species as the crows, the robins, the tits, the warblers, the thrushes, the saddleback, the bush-creeper, the yellowhead, the whitehead, the wrens, the tui, the bell-bird, the pigeon, and the parrakeets that the presence of the weka is an unmixed boon. If they

still continue to survive it is to his ceaseless vigilance, his policing of the woods, his eternal patrol of them by day and night, that we owe their lives; and these species, we may say, he watches without reward. From other kinds aided in the struggle for life, such as rails, ducks, pukeko, possibly, and from the fern-bird and ground-lark, certainly he does take fair toll. It is a tribute levied fit and fair, and the merest fraction of what is robbed by rats; a mere nominal fee, in fact, charged for life insurance.

"The larger kinds of birds, such as kiwis, hawk, falcon, &c., under normal conditions watch their eggs too carefully to give the weka a chance. If in any way his presence in the woods affects these birds it is to ensure a high degree of faithful incubation. To them he is a tonic against sloth and carelessness.

"If, then, in New Zealand any serious interest ever comes to be taken in our native birds, the most efficient method of preserving the smaller tree-breeding species lies in the propagation of the weka. Of all the birds that deserve our care he comes foremost, and assistance withheld from him is help denied to half the indigenous birds of New Zealand."

If, then, the present writers have demonstrated in the previous pages of this series the overwhelming proportion of good in the activities of our indigenous birds, they have at the same time proved the economic necessity of efficient protection for the weka. All wekas are protected by law; but an intelligent appreciation by country dwellers of the birds' claims to such protection is also desirable.

The black woodhen (*G. brachypterus*) is largely a shore-frequenting species, found only in the south-west of the South Island and living largely on marine productions, but Philpott has described its behaviour during a plague of mice, which the birds were "snapping up" in large numbers.

THE SHORE-BIRDS.

The indented coast-line of New Zealand, its numerous lagoons and mud-flats, and the extensive valleys of the large South Island rivers support a large population of shore-birds, *Limicolae*, or plovers and their allies. They include twenty-nine species, some of them notable the world over for the tremendous journeys they accomplish twice annually on migration. Here we are concerned with them—or rather with only a very small proportion of them, since many are very rare, or only accidental visitors—from two viewpoints. Firstly, practically all are insectivorous to a certain extent, some almost wholly so, while others subsist largely on molluscs (so-called "shell-fish") and crustaceans (shrimps, crayfish, crabs, and their allies); and, secondly, they form a source of food-supply which has not yet been developed so extensively in New Zealand as elsewhere. A few common species may be taken as examples.

The Godwit (Vetola lapponica (Linn.)).

The godwit, commonly known as "curlew" or "snipe" (both erroneously), arrives in New Zealand in enormous numbers in spring from its breeding-haunts in Siberia, to which it returns when our southern summer draws to a close.

In spite of its great abundance, the godwit enters into little actual relation with farming operations. Its food is sought on the mud-flats exposed at low tide on estuaries and inlets.

Under the Animals Protection and Game Act this species finds a place in the Third Schedule as native game.

The Banded Dotterel (Cirrepidesmus bicinctus (Jard et Selby)).

This plentiful and beautiful little plover, with its greyish back and black-and-chestnut barred white underparts, is a familiar inhabitant of the beaches and sand-dunes in many parts of New Zealand, and a very frequent visitor to cultivated and pastoral country. On occasion it may even choose a nesting-place on arable land, laying its

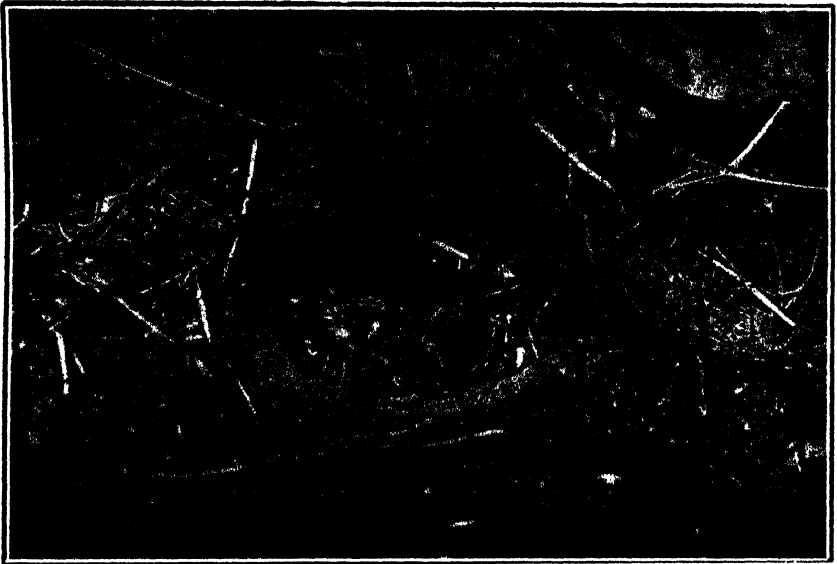


FIG. 2. NEST OF BANDED DOTTEREL; SHOWING A YOUNG BIRD JUST HATCHED AND ANOTHER COMMENCING TO CHIP THE EGG.

beautifully blotched dark-brown and olive eggs in a mere depression of the ground, sheltered perhaps by an overarching leaf of turnip or rape.

Few birds are so entirely harmless and at the same time so positively beneficial to agriculture as this little species. The diet is very largely insectivorous.

Like its rarer cousin the other dotterel (*Pluviorhynchus obscurus* (Gm.)), the banded dotterel is absolutely protected.

Other Shore-birds.

The knot (*Canutus canutus* (Linn.)), which in the Nelson Province at least (H. Hamilton) shares with the godwit the incorrect title of "snipe," is another migrant plover, far commoner in New Zealand

during the summer than has hitherto been generally realized. Together with the less plentiful turnstone (*Arenaria interpres* (Linn.)) and the eastern golden plover (*Pluvialis dominicus* (Muller)), the knot is placed on the Third Schedule as native game.

The stilts (*Himantopus* spp.), of which two kinds, a pied and a black, occur in New Zealand, are remarkable in that they possess longer legs in proportion to their size than any other bird. The edges of lagoons, the shores of lakes and of the larger rivers, and portions of the coast itself are the haunts of these birds and the source of their food, which consists largely of aquatic or semi-aquatic insects and small molluscs. They are absolutely protected.

The oyster-catchers (*Haematopus* spp.), sometimes called torea or red-bill, are almost entirely birds of the shore and river-flat. As in the case of the stilts, one species is pied and the other black. Their diet consists chiefly of crabs and molluscs, for opening which the long wedge-shaped bill is especially adapted. Both species receive permanent protection.

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Contagious Mammitis.—The last annual report of the Department of Agriculture states that this disease is still giving considerable trouble in dairy herds throughout the Dominion, and the advice and assistance of the Department's officers has been much sought after. Unfortunately, however, before the cases are reported they are, in a large number of instances, in an advanced stage of the disease, and little help can be given. Of 1,051 samples of milk received at the Department's Veterinary Laboratory during 1922-23 from cases of suspected contagious mammitis, 404, or 38 per cent., proved on examination to be of the contagious form; 218 were from cases of the non-contagious type; and the remainder (429) were normal. Wrong handling of milking-machines is often responsible for setting up udder troubles, and also for the spread of contagious-mammitis infection. The necessity for the exercise of every care cannot be too strongly emphasized.

Rabbit-proof-fencing District.—The constituting of the Te Aria Rabbit-proof-fencing District, South Auckland, has been gazetted.

THE LUCERNE-SEED CROP.

J. M. SMITH, H.D.A., Assistant Instructor in Agriculture, Marton.

THE value of acclimatized or local seed in practically all classes of farm crops is becoming more generally recognized by the farmers of this country. Perhaps this applies more to lucerne than to any other class of seed. It is a well-known fact that the variety of lucerne known as Marlborough is best suited to our conditions, and gives bigger yields and grows more vigorously than any imported variety that has not been acclimatized to this country. Our Marlborough lucerne was, of course, at one time imported, but it has been seeded and reseeded in the Marlborough District for so many years that it has now become accustomed to our equable climate, and is quite a different plant from the original imported variety. The same has been found in other countries. In Australia, for example, we find Tamworth lucerne and Hunter River lucerne; these varieties were imported probably from Asia, and grown and seeded year after year until they grew right away from the original variety—so much so, in fact, that they were renamed after the district in which they were acclimatized.

That Marlborough should be practically the only district in the Dominion producing lucerne-seed is not altogether strange. It must be remembered that the district has long been the home of lucerne in this country, and that it has a climate admirably suited for the production of seeds generally. But Marlborough is not the only district where lucerne-seed can be produced quite successfully; there are other districts that have a favourable climate and where lucerne grows quite well. The time may not be far distant, indeed, when these districts will be growing seed equal to the best Marlborough.

Up to a certain point the growing of lucerne for seed does not differ from the growing of it for hay. In fact, even if a crop is being left for seed, and for some reason or other the seed does not set well, there is still time to use that crop for hay. Much has been written as to the advisability of seeding only thin stands and stands sown in wide drills, but thick broadcast stands can be seeded equally as well as the thin or wide-drilled stand. First-year crops of lucerne should never be seeded, as the stand is then never properly established, and the proportion of weeds in a first-year crop is usually large. If the lucerne does well during the second year a seed crop could be taken from it, but as a rule it will not pay to seed a lucerne stand until the third season of its growth.

The first cut of lucerne in a season is usually made about November, and as the weather at that period is often far from certain it will generally pay to make this crop into ensilage. Even if the weather is suitable the first cut in a season ripens very unevenly, and as a rule is not the cleanest. The crop for seed should be shut up in December, and it will then be ready for harvesting about March. This will be the second cut of the season, or, if the season has been early, the third. It is not wise to leave the seed crop till too late in

the season, as it may put the harvesting into bad weather, and the climatic conditions are more the determining factor in good seed-production than any other.

It is thought by many that by allowing the lucerne-plants to reach maturity, as is the case in a seed crop, the stand itself is considerably weakened. This is not so; a stand that is left for seeding usually improves, and comes away much better after cutting. Also, there is no finer smother-crop than lucerne that has been allowed to grow to maturity.

Various theories have been put forward as to the means by which lucerne is pollinated, but it is generally understood that unless the bees are working freely among the lucerne-flowers very little seed will set. When the lucerne-flower reaches maturity it "trips," or, in other words, the flower allows the pistil to clear itself of the keel or



LUCERNE-SEED CROP IN FULL BLOOM.

boat-like structure formed by the two lower petals. This tripping may occur naturally, but more often it is brought about by the intervention of insects. Thus the flower may pollinate itself, but this is never so satisfactory as the cross-pollination by insects. If heavy rain falls during this pollination the setting of the seed will be, as a rule, unsatisfactory. Cold weather will have the same effect, as very little natural tripping takes place when the temperature is low. The ideal seeding-weather is when there is a comparative shortage of moisture during the final stages of growth.

To determine the right time to cut for harvesting requires considerable judgment, and it will depend to some extent upon the way the crop is to be subsequently handled. For instance, if the crop is to be cut with the reaper-and-binder it will need to be practically

dead-ripe, so that no undue sweating occurs within the sheaves; but where the mower is to be used it may be cut a little early, but not before the seed is properly set, and the ripening done in the swathe and cock. If the crop is to be handled by this latter method it should be cut when the pods are in the dark-brown stage and the leaves have practically all fallen. Lucerne does not ripen very evenly, and if one waits for the last pods to mature a great deal of the seed will have shed. The grower will thus have to judge the time when the greatest number of the pods are at the right stage. In harvesting the aim should be to get the material to the threshing-mill at the right stage with as little handling as possible, as handling at this stage, no matter how carefully done, causes a number of the pods to burst and the seeds to fall.

In cutting a side-delivery machine should be used, and, failing this, the machine should be followed by men with forks, who shift the cut material over so that the horses do not tread on it in the following round. The lucerne should be left in the swathes for a day or two, dependent upon the stage at which it was cut, and should then be raked carefully into windrows until dry enough for stacking. If suitable weather prevails it can be threshed quite well from the field, but as a rule it will need to be stacked. The stack should be well covered, as the ingress of water to a lucerne-seed stack plays havoc with the seed. If a barn or shed is available so much the better, as no care is too great for the lucerne crop. If put into a stack it should be left some thirty days or so before threshing, as the mass usually goes through a sweating stage during which the seed softens, and threshing should not take place before the seed hardens again. Also, the seed threshes out much better if left for some little time in the stack.

Threshing is done by means of the ordinary clover-sheller, but a larger riddle will be required for lucerne than is the case with clover. No threshing-mill cleans the seed sufficiently for the market, and a careful recleaning is necessary.

The straw after threshing is of very little value, but where it can be used to advantage is in the ensilage stack when the material is brought in in too wet a state. Here green lucerne and lucerne-straw seem to even each other up, and the resultant ensilage is good. It is not advisable to use the straw for this purpose except where the green material is exceptionally wet. If there is no other use for it the stock may be given free access to the straw-stack, and they will pick a good deal of feed out of it.

Rough-handling of Freezing-stock.—The supervising graders of the Meat Board have drawn attention to the damage to lambs and sheep caused through rough handling during transit to freezing-works. A great deal of this bruising is caused through the wool being pulled in drafting and trucking by shepherds and drovers who catch hold of the animal by the wool. Much damage is also traced to bites inflicted by drovers' dogs. Carcases which are only slightly damaged are classed second quality, while the more seriously damaged ones have to be totally rejected for shipment. The Board urges that, apart from the serious loss to the producer or buyer and the effect on the appearance of our meat exported, it is incumbent on farmers to see that attention is given to this matter for the purpose of eliminating much suffering to the animals *en route*.

ROOT-DEVELOPMENT OF LUCERNE.

Synopsis of thesis on "A Physiological Study of the Root-development of Lucerne (*Medicago sativa*) under varying Conditions of Water-supply and Fertilizer (Superphosphate)."

B. M. DAVIS, M.Sc., Department of Agriculture.

DURING 1922 the writer carried out work at Canterbury University College with the object of ascertaining, in so far as was possible, the effects of an application of superphosphate on lucerne-roots. The complete paper was presented as the thesis required for a Master's degree in the University of New Zealand.

Briefly, the method employed was to grow lucerne from seed in specially prepared vessels, to extract the entire root-system by means of a stream of water, measure it, and tabulate the results. Precautions were taken to secure maximum uniformity of soil, drainage, compaction, lighting, &c. The experiment was divided into three series, represented by plants receiving 15 in., 30 in., and 60 in. of rainfall per annum respectively. Each series was composed of two parts—namely, those plants receiving superphosphate at the rate of 2 cwt. per acre, and those receiving none. Examination of plants was made in each series after four, eight, and twenty weeks from germination.

The results, summarized, were as follows :—

(1.) The depth of penetration of the main tap-root was less in the case of the plants receiving fertilizer than in those receiving none. This was true for plants receiving 30 in. and 60 in. of rain, but the position was reversed for those receiving 15 in.

(2.) The laterals and tap-root were of a somewhat less diameter in the plants receiving fertilizer than in those receiving none. No regular difference was ascertained as regards the "diameter-quotient"—*i.e.*, the relative diameters of cortex and conducting tissues.

(3.) There was an increased amount of root developed in the surface soil in the case of those plants receiving fertilizer. The reverse was true in this investigation for the twenty-week plants.

(4.) Superphosphate did not result in the production of an increase in the total root-production, but exercised a depressing effect when combined with (a) heavy rainfall, or (b) light rainfall.

(5.) The efficiency of the roots judged from "The nutritive efficiency index" with 30 in. of rain was not altered by an application of superphosphate, but it was considerably so in the case of 15 in. and 60 in., and to approximately the same extent in both cases, the efficiency becoming much greater with an application of superphosphate. (A measure of the relative efficiency of roots may be obtained by dividing the weight of foliage produced by the total length of root-laterals.) This gives the amount of green material that may be considered arbitrarily as coming from 1 centimetre of root. By neglecting the noughts following the decimal point and treating the expression as a whole number the "nutritive efficiency index is obtained.) This is clearly a subject for further research.

(6.) Superphosphate adversely affected the germination of the seed.

It should be recognized that the plants of this investigation were grown under peculiar conditions—*i.e.*, in a greenhouse, throughout winter, with artificial heat at night. Moreover, the results apply to only one particular type of soil (a more or less virgin sandy loam) under these conditions. Correlated with similar experiments, and with investigations in the field, the results should prove a useful lead.

ACIDITY-REDUCTION IN CREAM.

A READY-RECKONER FOR USE OF SODA IN BUTTER-MAKING.

Dairy Division.

THE following table gives the amount of bicarbonate of soda required to reduce practically any quantity of cream any number of points. It is not claimed that it is correct under all conditions, this being chiefly due to the variation in the strength of the soda, but it is so close that if used in conjunction with the acidimeter no overdosing with soda is likely.

--	Percentage of Reduction desired.												
	0.10	0.11	0.12	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20	0.22	0.24
Pounds of Cream	Pounds of Soda required.												
500	0.41	0.46	0.50	0.54	0.58	0.62	0.66	0.70	0.75	0.79	0.83	0.92	1.00
600	0.50	0.55	0.60	0.65	0.70	0.75	0.80	0.85	0.90	0.95	1.00	1.10	1.20
700	0.58	0.64	0.70	0.75	0.81	0.87	0.93	0.99	1.05	1.10	1.16	1.28	1.40
800	0.66	0.73	0.80	0.86	0.93	1.00	1.06	1.13	1.20	1.26	1.33	1.46	1.60
900	0.75	0.82	0.90	0.97	1.05	1.12	1.20	1.27	1.35	1.42	1.50	1.64	1.80
1,000	0.83	0.91	1.00	1.08	1.16	1.25	1.33	1.41	1.50	1.58	1.66	1.83	2.00
1,100	0.91	1.00	1.10	1.19	1.28	1.37	1.46	1.55	1.65	1.74	1.83	2.00	2.20
1,200	1.00	1.10	1.20	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.20	2.40
1,300	1.08	1.19	1.30	1.40	1.51	1.62	1.73	1.84	1.95	2.05	2.16	2.38	2.60
1,400	1.16	1.28	1.40	1.51	1.63	1.75	1.86	1.98	2.10	2.21	2.33	2.56	2.80
1,500	1.25	1.37	1.50	1.62	1.75	1.87	2.00	2.12	2.25	2.37	2.50	2.74	3.00
1,600	1.33	1.46	1.60	1.73	1.86	2.00	2.13	2.26	2.40	2.53	2.66	2.92	3.20
1,700	1.41	1.55	1.70	1.84	1.98	2.12	2.26	2.40	2.55	2.69	2.83	3.11	3.40
1,800	1.50	1.65	1.80	1.95	2.10	2.25	2.40	2.55	2.70	2.85	3.00	3.30	3.60
1,900	1.58	1.74	1.90	2.06	2.21	2.37	2.53	2.69	2.85	3.00	3.16	3.58	3.80
2,000	1.66	1.83	2.00	2.17	2.33	2.50	2.66	2.83	3.00	3.16	3.33	3.66	4.00
3,000	2.50	2.75	3.00	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.50	6.00
4,000	3.33	3.66	4.00	4.33	4.66	5.00	5.33	5.66	6.00	6.33	6.66	7.33	8.00
5,000	4.16	4.58	5.00	5.41	5.83	6.25	6.66	7.08	7.50	7.91	8.33	9.16	10.00

		Percentage of Reduction desired.												
		0.26	0.28	0.30	0.32	0.34	0.36	0.38	0.40	0.42	0.44	0.46	0.48	0.50
Pounds of Cream.		Pounds of Soda required.												
500	..	1.08	1.16	1.24	1.33	1.41	1.50	1.58	1.66	1.75	1.84	1.91	2.00	2.08
600	..	1.30	1.40	1.50	1.60	1.70	1.80	1.90	2.00	2.10	2.20	2.30	2.40	2.50
700	..	1.51	1.62	1.74	1.86	1.98	2.10	2.21	2.33	2.45	2.56	2.68	2.80	2.91
800	..	1.72	1.86	2.00	2.12	2.26	2.40	2.52	2.66	2.80	2.92	3.06	3.20	3.33
900	..	1.95	2.10	2.25	2.40	2.55	2.70	2.84	3.00	3.15	3.28	3.45	3.60	3.75
1,000	..	2.16	2.32	2.50	2.66	2.83	3.00	3.16	3.32	3.50	3.64	3.83	4.00	4.16
1,100	..	2.38	2.56	2.75	2.92	3.11	3.30	3.48	3.66	3.85	4.03	4.20	4.40	4.58
1,200	..	2.60	2.80	3.00	3.20	3.40	3.60	3.80	4.03	4.20	4.40	4.60	4.80	5.00
1,300	..	2.80	3.02	3.25	3.46	3.68	3.90	4.11	4.32	4.55	4.76	4.98	5.20	5.41
1,400	..	3.03	3.26	3.50	3.73	3.98	4.20	4.42	4.66	4.90	5.12	5.36	5.60	5.83
1,500	..	3.25	3.50	3.75	4.00	4.25	4.50	4.75	5.00	5.25	5.50	5.75	6.00	6.25
1,600	..	3.46	3.72	4.00	4.26	4.52	4.80	5.06	5.32	5.60	5.86	6.13	6.40	6.66
1,700	..	3.68	3.96	4.25	4.52	4.81	5.10	5.38	5.66	5.95	6.23	6.51	6.80	7.08
1,800	..	3.90	4.20	4.50	4.80	5.10	5.40	5.70	6.00	6.30	6.60	6.90	7.20	7.50
1,900	..	4.11	4.43	4.75	5.06	5.38	5.70	6.01	6.33	6.65	6.96	7.28	7.60	7.91
2,000	..	4.33	4.66	5.00	5.33	5.66	6.00	6.32	6.66	7.00	7.32	7.66	8.00	8.33
3,000	..	6.50	7.00	7.50	8.00	8.50	9.00	9.50	10.00	10.50	11.00	11.50	12.00	12.50
4,000	..	8.66	9.33	10.00	10.66	11.32	12.00	12.66	13.33	14.00	14.66	15.33	16.00	16.66
5,000	..	10.83	11.66	12.50	13.32	14.16	15.00	15.83	16.66	17.50	18.32	19.16	20.00	20.83

Careful experiment with cream ranging from 0.2 to 0.7 per cent. of acidity has shown that 1 lb. of Crescent brand soda (the brand most commonly used) will reduce the acidity of 1,000 lb. of cream 0.12 per cent., and the table has been calculated from these figures. The first column represents the number of pounds of cream to be utilized. The top line is the percentage of acidity to be taken out of the cream, not the acidity of cream, in the vat. To find the number of pounds of soda required subtract the acidity desired from the acidity of the cream in the receiving-vat, then follow along the line opposite the number of pounds of cream in the vat until the column under the percentage of acidity to be taken out is reached. For example, the reduction of 1,500 lb. of cream from 0.5 to 0.2 will require 3.75 lb. of soda.

For the table to be of value every care must be taken. The quantity of cream must be known to a few pounds. It must be thoroughly mixed so that the sample tested is representative of the whole. The test must be properly made, and the soda weighed correctly and completely dissolved. The soda solution must be carefully stirred into the cream. To get the weight of cream correct add up the suppliers' dockets as the cream is being weighed in, and put a mark on the vat for each 100 lb. added.

Board of Agriculture.—Mr. W. D. Pike, of Blenheim, has been appointed as a member of the Board of Agriculture, representing the Marlborough, Nelson, and Westland Districts, in place of the late Mr. J. A. Haycock.

STRYCHNINE AND ITS POISONOUS ACTION.

TREATMENT IN CASES OF ACCIDENT.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

STRYCHNINE is a plant alkaloid of very decided characteristics. The alkaloids (from *al-kali*, an Arabic word meaning "ashes," and *eidōs*, a Greek word meaning "resemblance"—literally "like an alkali") are a class of organic bodies burning away completely on ignition, and are highly analogous to the inorganic bases, the alkalis, which are incombustible.

Alkaloids resemble the alkalis generally in having an alkaline reaction, in neutralizing acid to form salts, and in many other respects. Familiar examples of other alkaloids are the nicotine of tobacco, a liquid alkaloid highly poisonous, and the caffeine of tea and coffee, and quinine from cinchona-bark, which are mildly poisonous. Examples of alkalis are soda, potash, and quicklime.

The alkaloids are obtained from many sources. Artificial alkaloids may be prepared in the laboratory, while the natural alkaloids may be obtained from either plants or animals. Those derived from plants are termed "plant alkaloids" or "plant bases." These vary greatly in their poisonous effects, their degree of poisonousness, their degree of stability, and their form.

Thus one of the most poisonous of all is nicotine, the fatal dose of which, for an adult human being not habituated to the use of tobacco, is 6 milligrams (0.006 gram, or 0.0925 grain), according to Wynter Blyth. Strychnine is far less poisonous than nicotine. Taylor estimated the fatal dose for adults as between 32.4 to 129.6 milligrams. Other alkaloids are so feebly poisonous that they can be taken in relatively large quantities. Tea-leaves contain from 1 to 5 per cent. of caffeine, and we know how much of this we daily consume. The alkaloid pukateine, which the writer isolated from the pukatea-tree, is so mildly toxic that it would take 17,000 milligrams, or about $\frac{3}{4}$ oz., to cause poisoning symptoms in an adult man. The writer has himself taken 100 milligrams without experiencing the slightest effect. If enough be taken it has a strychnine-like action.

Some alkaloids are unstable—that is, they decompose into other compounds; but strychnine is extremely stable, and may be detected in animal-remains years after death. The skeletons of rabbits poisoned by strychnine may therefore remain poisonous for years, as the dried flesh and viscera adhering to the bones still contain the unaltered poison.

The form of alkaloids varies. Some few are coloured, but most are white when pure; some are liquids, but most are solids; some are non-crystalline, but many are either crystalline or form crystallizable salts with the common mineral or organic acids. One discovered by the writer in pukatea-bark—laureline—is itself amorphous or non-crystalline, but forms beautifully crystalline salts.

Alkaloids also vary in their volatility, solubility, taste, smell, the reactions which they give with oxidizing chemicals, and in their

physiological action on animals—some, like morphine, acting as narcotics in inducing torpor or sleep ; others, like caffeine, as excitants and stimulants, induce wakefulness. Hence one alkaloid may be used as an antidote for another, and this treatment is very valuable if applied in time.

SOURCE AND NATURE OF STRYCHNINE.

Strychnine is obtained from the seed of the nux-vomica tree (*Strychnos Nux Vomica*), of the family Loganiaceae, a small tree indigenous to India, Siam, and northern Australia. Another source is from St. Ignatius "beans," which are the seeds of *Strychnos Ignatii*, a stout climbing-plant indigenous to the Philippine Islands. There are two alkaloids in *Strychnos* seed—namely, strychnine and brucine—which exist in nearly equal proportions, totalling about 3 per cent. of the seed. The seed is known in commerce as "beans" ; "seed" is, however, the correct botanical description. In New Zealand there is no member of the genus *Strychnos* ; *Geniostoma ligustrifolia*, a common shrub in the North Island, belongs to the same family as *Strychnos*, but apparently contains no poison. There are many other species of *Strychnos* inhabiting the warmer parts of the world, but the foregoing are the most important.

Strychnine is sold usually in the form of colourless, transparent, prismatic crystals, or, when powdered, as a white crystalline powder, odourless, but having an intensely bitter taste, which is perceptible in solutions as dilute as 1 of strychnine in 70,000 of water. (*Strychnine should, of course, be tasted with extreme caution.*) The crystals are non-volatile and permanent in air, not changing in colour or nature as do some other alkaloids. To dissolve 1 part of strychnine it takes 6,000 parts of water, or 110 parts of alcohol, or 5,500 parts of ether, or 6 parts of chloroform. Strychnine melts at a temperature of 268° centigrade (514° F.), and on raising the temperature higher it burns away, leaving no ash. Its solution turns red litmus test-paper blue (alkaline reaction). Its behaviour to concentrated sulphuric acid is unusual, for on adding a drop to a crystal on a white saucer no charring or other coloration occurs, but on adding a crystal of bichromate of potash to the solution in concentrated sulphuric acid a deep-blue colour is produced, which changes quickly to a deep violet, purplish-red, cherry-red, and finally to orange or yellow. This play of colours which strychnine gives with sulphuric acid and bichromate of potash is the convincing test for strychnine. The smallest particle will give this reaction ; nor is any other compound known which gives the same brilliant colours in the same sequence as stated, although some alkaloids do give colour reactions with this reagent. No suspected substance can be held to be strychnine unless it is extremely poisonous, excessively bitter, and gives the foregoing colour reaction.

Strychnine, although practically insoluble in pure water, dissolves readily if the water is acidulated with any of the common mineral acids, or with vinegar, acetic acid, and some other organic acids. Salts of strychnine made by combining it with hydrochloric, nitric, or sulphuric acid are obtainable in the form of fine white crystals, which are soluble in water. They have the poisonous properties of strychnine, but have not proved as efficacious in practice as a vermin-poison. It is important that buyers of strychnine for poisoning rabbits and birds should specify

that the base strychnine is required and not any of the salts of strychnine. Strychnine will be in bottles labelled as such, whereas the salts will be labelled "strychnine sulphate," "strychnine hydrochloride," or "strychnine nitrate," or some abbreviation to denote these names.

POISONOUS ACTION OF STRYCHNINE

Strychnine has long been used as a vermin-poison. In poisoning flesh-eating animals or birds it was recommended to insert the alkaloid in the stomach of a small animal recently killed. The poison thence became diffused throughout the carcase, which formed the bait. In poisoning birds with strychnine it was the practice to sell grain which had been steeped in a solution of the alkaloid. This grain is not nearly so effective as that prepared by dusting the finely powdered poison on to the damped grain. In poisoning with strychnine it is desirable, by using liberal quantities, to avoid undue cruelty. The animal then obtains a lethal dose and quickly succumbs.

Strychnine is extremely poisonous to all kinds of life, although some animals are more susceptible than others to this poison.* Thus the fatal dose when injected under the skin of a rabbit is from 0.5 to 0.6 milligram per kilogram ($2\frac{1}{2}$ lb.) of body-weight, but a domestic fowl will require four times this quantity. Indeed, fowls are so resistant to strychnine that they are sometimes regarded as immune to that poison. Two incidents may be quoted which illustrate this: Some fowls (culls) were put in a pen, and a mash of pollard and strychnine given. The small birds came down in hundreds and fed with the fowls as usual. The fowls showed only a slight "grogginess" afterwards, whereas the small birds perished. A farmer, suspecting that his poisoned wheat was not up to strength, gave it to some fowls to try, and was wrongly confirmed in his suspicions when nothing happened to the fowls. Strychnine is certainly the most suitable poison for small birds, as the writer has shown in Leaflet No. 66 (printed in 1903), which is still available, though amended by a later article. In this method the strychnine, in fine powder, is dusted on to the wheat, which has been damped with a sugary solution (see *Journal*, August, 1917, p. 68).

The rabbit is one of the most susceptible animals to strychnine poison, and in field practice it has been found that when the crystals, finely powdered, are distributed on the bait, consisting of sliced or minced carrots, swede turnips, or apples, the poisoning is most effective. The proportions used are those first recommended in the above-referred-to leaflet for birds (see *Journal* for January last, or Bulletin No. 110). A mixture of oats and molasses has been used as a bait very effectively, and has the advantage that the ingredients may always be had when other baits are unobtainable.

There are several points which are worth investigating with regard to the use of strychnine for destroying vermin in New Zealand. Strychnine is very expensive, although a highly efficient poison, costing

* When given by the mouth, as in field practice, it is probable that much more strychnine is required as a lethal dose than when injected under the skin. The minimum fatal dose of tutin, the active principle of the tutu-plant (discovered in this Laboratory), injected is 2.5 milligrams; when given by the mouth it is 6 milligrams.

5s. per ounce even when imported in wholesale quantities. It is probable that the demand will grow and that very large quantities will be required in future. It seems reasonable that the strychnine should be received on the farm already powdered, or in such small crystals that powdering is unnecessary. What should we think if farmers were asked to powder their their own fertilizers on the farm? Powdering on the farm leads to waste, delay, and danger. A mortar which is used for powdering strychnine one day may be used for making icing-sugar for the wedding-cake the next, and then a funeral may not be far off. Of course, it is easy to clean the mortar thoroughly by washing it with acidulated water, but this in the hurry of farm-work may be overlooked.

Of the two alkaloids in the *Strychnos* seed, only the strychnine is used, but as the brucine is also poisonous (through less so than strychnine) it might be advisable to ascertain what the total crude alkaloids from the extraction of the seed could be supplied at, and whether the reduction in price would warrant its use. It might also be possible to grow the seeds in some of the tropical territories of this Dominion, and thus create a new industry.

POISONING OF HUMAN BEINGS AND DOMESTIC ANIMALS.

The action of strychnine on the animal-body is as distinctive as those reactions it gives to chemical tests. A medical man is not likely to mistake the symptoms produced by strychnine for those produced by any other cause. No one who has ever seen a dog poisoned by strychnine and the stretched-out rigid appearance the body assumes in the convulsions will ever forget the sight.

In the poisoning of human beings by strychnine the symptoms come on very quickly—usually in from five to twenty minutes. Usually when taken accidentally the patient is warned by the excessively bitter taste of the strychnine compound that something is wrong. If so, the sooner an emetic can be administered and vomiting induced the better, as strychnine is absorbed with great rapidity, and the longer the administration of the emetic is delayed the less chance there is of effective removal of the poison.

The prominent symptoms which follow the taking of the poison are, firstly, a sense of uneasiness and restlessness, and a feeling of impending suffocation; then a shuddering or trembling, with twitchings or jerkings of the limbs and head. Finally, these are succeeded by convulsions in which nearly all the muscles are simultaneously affected; the limbs are stretched involuntarily, the hands are clenched, the soles of the feet bend inwards, the legs somewhat separated. The body becomes arched, the head bent forcibly backwards, and the front of the body is projected, so that the patient rests on the back of the head and heels, the neck is stiff, and the body unnaturally rigid. Slight causes bring on the convulsions, such as a noise, the banging of a door, &c.

There is no loss of consciousness during these attacks, the intellect being quite clear to the last, and the horror of impending death is very acute, and is manifested in the expression on the patient's face, who fears to be left alone. There are other symptoms, but the foregoing

are sufficient to indicate what a horrible poison strychnine is, and how necessary it is to guard against the poison being accidentally taken. The fatal dose for adults ranges from $\frac{1}{2}$ grain to 2 grains. Records show that in the majority of cases if a patient survives the first two hours after taking the poison he, as a rule, makes a complete recovery.

The following is the procedure recommended by the Health Department for strychnine poisoning in the case of human beings:—

If a person has, accidentally or otherwise, swallowed any strychnine, act quickly as follows:—

- (1.) Send for a doctor.
- (2.) Before doctor arrives, give emetic such as mustard or common salt, one tablespoonful in one half-pint of warm water. After vomiting has been induced give three grains (as much as will conveniently lie on a threepenny-piece) of potassium permanganate in one half-pint of water, or give strong tea, or charcoal suspended in water.
- (3.) After doctor arrives he will treat other symptoms.

The treatment recommended by the Live-stock Division for strychnine poisoning in the case of domestic animals is as follows:—

General: Keep the animal quiet, warm, and comfortable.

Dogs and cats: Give an emetic consisting of a solution of common salt or mustard, followed by a purgative of Epsom salts and any of the preparations recommended for other animals.

Horses, cattle, sheep, and pigs: A purgative should at once be administered—Horses, linseed-oil; cattle and sheep, Epsom salts; pigs, castor-oil. This should be followed by turpentine, chloral hydrate, or chlorodyne—whichever is at hand.

Doses: Turpentine in oatmeal gruel—horses a wineglassful; cattle, two wineglassfuls; sheep and pigs, a teaspoonful; dogs, ten to twenty drops. Chloral hydrate or chlorodyne—horses, 1 oz.; cattle, 2 oz.; sheep and pigs, one teaspoonful; dogs and cats, ten to twenty-five drops of chlorodyne, or $\frac{1}{2}$ dram of chloral hydrate.

GRADING OF NEW ZEALAND HONEY FOR EXPORT.

Horticulture Division.

THE following notes have been prepared with a view to presenting the objects aimed at and methods followed in the grading of honey for export, as adopted by the New Zealand Department of Agriculture and carried out by the Apiary officers of its Horticulture Division.

Primarily honey is graded to ensure evenness of colour, flavour, and packing, to safeguard the name of our product on the oversea markets, to ensure that unripened honey shall not be despatched, and to prevent odd lines of honey collected from the various districts being exported irrespective of quality, colour, or packing.

STANDARDS AND GRADES.

The differing flora from which honey is derived in New Zealand and the varying seasons make the process of classifying honey into grades somewhat difficult. However, after due consideration in dealing

with the classes of honey produced, it has been possible to evolve standards for colour and flavour quite suitable for the grading of all honey offered for export. At the inception of our grading-system, when the standards were being evolved, it was necessary to hazard to some extent the requirements of the British markets. The same opportunities had not been presented to the graders of honey as to graders of other produce to determine the actual requirements of the British merchants in respect to flavour and colour. With no first-hand information the only guide to the situation was the price obtained for shipments of honey from time to time. It was noticed that the water-white and white honeys, which are delicately flavoured, invariably brought higher values than honeys darker in colour and more pronounced in flavour. Taking the white honeys as a basis, it was recognized that all New Zealand honey could be placed into three grades. These were designated Special, Prime, and Good.

Reference here to the grades would not be complete without some definition of those classed under the headings just mentioned. Special-grade honey is one having a choice delicate flavour, bright in colour, delicate in aroma, fine in grain, firmly conditioned, free from scum, and well packed. Prime grade may be an excellent table honey, but with a flavour more pronounced than allowable in Special grade. Good grade may be a fair honey and suitable to some palates for table use. In all grades honeys of finer flavour may be reduced to a lower grade through loss of points in items other than flavour.

COLOUR.

It is obvious that as the honeys produced vary considerably in colour, ranging from water-white to dark, no system of grading would be complete unless allowance were made for classifying the honey exported into separate colour-classes. Thus provision is made for five colour-classes—namely, water-white, white, light amber, medium amber, and dark. Consequently all honey for export, besides being divided according to texture and flavour into either Special, Prime, or Good grade, is further subdivided according to colour into the classes of water-white, white, &c., just referred to.

When a sample is taken for determining the colour it is carefully melted and placed into a small tube and compared with the colour-glasses, and, if clear, is posted to its colour-class. If the sample when melted is found to be cloudy or dull, and the characteristic brightness is absent, the small bottles containing the honey are placed in a Babcock tester and revolved, this operation throwing all the air-bubbles, &c., to the surface, and in this way a true estimate of the colour is obtained. Should the honey after the latter operation remain dull in appearance points are deducted under the heading of "Colour" when the score is being made out.

Notwithstanding that a sample from each separate line or case of honey, if necessary, is melted, considerable difficulty is experienced at times in determining the placement of border-line colours. In all cases where liquefying is necessary to determine colour, great care has to be exercised in order to avoid overheating during the melting process, otherwise the particular sample is apt to be relegated to a darker class than that to which it really belongs. With few exceptions

the determining of colour without first liquefying a sample of the honey will prove unreliable; consequently any effort to gauge colour by the appearance of the honey in the tins would be far from complete, and would make for the incorrect classification of the honey.

CONDITION.

Another important factor to be considered is that of condition. Honey in good condition should be firmly granulated, free from the slightest trace of ferment, and, if contained in airtight containers, keep indefinitely if not subjected to high temperature. The bulk of the honey produced in the Dominion granulates firmly. However, it sometimes happens that through careless manipulation or other causes a beekeeper sends forward for export lines which are termed "soft granulated." When honey the keeping-quality of which is doubtful is met with in the grading-store its possibilities in the direction indicated are immediately tested by means of a specific-gravity test. If a liquid sample of the honey at a given temperature registers below 1.420 it is not considered sufficiently ripe for export. The specific-gravity test used has been the cause of the rejecting of quantities of honey, and without its use no doubt a much larger quantity would have found its way to the British market in a fermented condition.

In the process of grading points are allotted for grain and freedom from scum. Honey of a gritty nature receives fewer points than that which possesses a nice smooth, even grain. Dealing with scum the grader uses his judgment as to the amount on the honey that will pass. Excessive scum containing wax-particles, dead bees, &c., results in lines being rejected for export.

FINISH AND PACKING.

Apart from the question of grading, the exporter is called upon to give some consideration to the finish and packing of the lines he is exporting. It is compulsory for the beekeeper to pack in new tins and strongly constructed cases. The tins have either to be oiled or lacquered as a prevention against rust, and they must not contain more than 60 lb. of honey. The cases are strapped with metal strapping as additional protection.

GRADE-STAMP AND CERTIFICATE.

When the honey is finally passed a grade-stamp is affixed to the cases, indicating the colour and grade of the honey. A grade-certificate covering each line so graded is then issued.

Noxious Weeds Orders.—The Tuapeka and Clutha County Councils have declared Californian thistle and ragwort *not* to be noxious weeds within their respective territories. The Waikouaiti, Waitomo, and Waikohu Counties have similarly declared Californian thistle only. The Kaikohe Town Board has declared gorse and Cape daisy to be noxious weeds within its district; the Papakura Town Board has similarly dealt with ox-eye daisy; and the Portobello Road Board with gorse and broom. The Tahunanui Town Board has declared all the plants in the Third Schedule of the Act to be noxious weeds.

CIDER - MAKING.

PRACTICE FOR NEW ZEALAND CONDITIONS.

(Continued.)

J. C. WOODFIN, Vine and Wine Instructor, Horticulture Division.

PREPARATION OF THE MUST.

THE apple-juice flowing from the press-cloths is generally fairly clear, though not entirely free from visible solids. To remove these it is advisable to run the juice through a couple of hair or wire sieves, the lower one having a finer mesh than the one placed immediately above it. The juice thus treated will be sufficiently clear to run directly into ordinary barrels to be fermented, or to be pumped from a temporary or specially constructed receptacle beneath the press into fermenting-vats in the cellars.

When sufficient juice has been conveyed into the fermenting-vessel, and before any fermentation sets in, the quantity of solids contained in the juice should be ascertained and duly recorded on the vessel itself, or in a book kept for the purpose. There are small quantities of matters other than sugar included in the total solids, but for practical purposes the whole can be considered as sugar.

The majority of orchardists possess a Baumé hydrometer with a scale from 0° to 50° for liquids heavier than water, which they use for testing the density of their lime-sulphur spray-solutions. The same hydrometer can be used for testing the density of apple-juice. In case such an instrument is not available it can be procured from one of the scientific-instrument sellers, together with a test-glass, for a few shillings. If purchasing a Baumé specially for cider-making it is preferable to obtain one graded from 0° to 20° or 25°. The degrees on these are farther apart on the scale and are therefore easier to read correctly.

The Baumé is graduated at 60° F. or 15° C., and the juice to be tested should be as near as possible to that temperature. Should the temperature be above 60° F., add 1 degree to the degree Baumé recorded for every 15 degrees F. above 60; or, if below, deduct 1 degree Baumé for every 15 degrees F. below. Read the degrees Baumé in a line with the main surface of the liquid, not at the point it has mounted to on the spindle by capillarity.

The Baumé hydrometer has an arbitrary scale as far as cider is concerned, but, as already mentioned, it is generally to be found in the hands of the orchardists or is easily procurable. By a happy coincidence the degrees Baumé (varying as a rule from 6° to 9°) in apple-juice, if reduced by 2, will give approximately the percentage of alcohol the cider will contain on complete fermentation. (Wine-makers will notice that the approximate ratio of sugar to solids in apple-juice is not the same as that in grape-juice.) Apple-juice registering 8° Baumé will result in a dry or hard cider containing very near to 6 per cent. of alcohol by weight.

The sugar contents of the must can be gauged more exactly by analysis, but the exact amount of alcohol that will be produced in the cider cannot be prognosticated exactly, as it will be rarely found that two barrels of juice, though made from the same varieties of apples, are of exactly the same composition, nor will they ferment out under exactly the same conditions. The indications obtained by the use of the Baumé hydrometer, as already explained, will be found on the analysis of the completely fermented cider to be very nearly exact—quite near enough for the purpose.

Should the saccharine contents of the must be insufficient to produce the alcoholic strength desired in the finished cider, then for each additional 1 per cent. of alcohol desired add 4 oz. of No. 1A cane-sugar to each gallon of must, dissolving it thoroughly by stirring. If, on the contrary, a lighter cider is required for quick home consumption after making, water can be added to reduce the solids. Only small quantities of either sugar or water should be employed; an excess of either will change the nature of the beverage. An addition of both sugar and water would constitute the fraud known among wine-makers as "stretching" or "sophistication."

The proportions of acidity and tannin in ripe New Zealand apples are generally suitable for making a good cider, and can be judged approximately by taste. The exact proportion need only be ascertained when making cider on a commercial scale, and will be dealt with later.

The practice of filtering the fresh apple-juice before fermentation is not advisable. The mucilaginous and albuminous nature of the solids clogs the filtering-material very rapidly, and renders the process very slow even under heavy pressure. It is, moreover, very doubtful whether apple-juice from which these substances, containing some of the food of the ferments, are extracted would produce a cider which would justify the extra cost and trouble. Filtration should be reserved for treating ciders that have not cleared naturally or after successive rackings, and when they are otherwise ready for bottling.

FERMENTATION.

The juice can be left in an open vat to ferment for a few days till a crust forms on the surface of the liquid, and a thick deposit, known as "lees," forms on the bottom of the vat. The crust is then skimmed off, and the clear juice is run off the lees into the fermenting barrels or vats. Many advantages are claimed for "keeving" as this process is called, the principal of which is that it rids the juice of undesirable solids. The principal objections to it are the cost of double handling and the extra vat required. Owing to the surface of the liquid being exposed to the air there is also more risk of contamination from vinegar bacteria, the bugbear of cider-makers. Besides those which may enter from outside, there are always a few of these organisms in the juice waiting for favourable conditions to increase. Exposure to the air furnishes these conditions, and for this reason, throughout the whole process of cider-making, the greatest care should be taken to avoid all unnecessary contact of the cider with the air.

A more rational method for the production of a high-class cider is to obtain the juice as clear as possible from the press and run it

directly into barrels or closed vats, filling them to the bung-hole or leaving a space above the liquid in the vessel. Fermentation will start spontaneously, and will generally be observed after two or three days, or it may take longer in the case of the first barrel or if the weather is very cold. In the barrels or vats which have been filled up, and in which fermentation has commenced, the froth will begin to ooze out of the bung-holes. These should be placed a little on one side, so as to allow the froth to run down one side only of the barrel into a basin, or a trough if there are several barrels, placed underneath. These barrels or vats should be kept filled up and the froth wiped away daily from the sides, and the basins emptied and cleaned, or the troughs swilled down with lime-water.

Where a space has been left above the must (about 6 in. in a 40-gallon barrel) the froth forms a crust on the surface, and sinks into the liquid when the first tumultuous stage of fermentation subsides. At this period the containing-vessel should be filled with fermenting juice from another barrel, or with cider from a previous brewing, or, failing both, with clean water.

By both of the foregoing methods a good cider can be produced, on condition that the utmost cleanliness is observed, and the barrels or vats are absolutely sweet and clean and free from vinegar and mouldy flavours when they are filled.

Where there is a choice of location for the purpose of fermentation the coolest one should be preferred, as, all other conditions being equal, the finest cider is produced by a slow fermentation at a low temperature. The ideal condition would be a uniform temperature of 40° F.—a condition which can only be obtained by artificial means, and the cost of which would be prohibitive to producers of small quantities.

Another most important condition both during and after fermentation is the exclusion of air from the surface of the cider. If a strong barrel with good sound hoops is used for fermentation, and a small space is left above the liquid, the barrel can be bunged down tightly as soon as the fresh juice is poured in. The gas formed by fermentation will escape through the pores of the wood, and the fermentation will proceed more rapidly than if the bung-hole were left open.

The objection to the foregoing procedure for the production of any but dry cider is that the progress of the fermentation cannot be followed by testing the liquid from time to time with the hydrometer, which will gradually sink as the sugar is split up into alcohol and gas by the action of the ferments or yeasts. As long as the air can be excluded from the surface of the cider there will be no danger of acetification. A sufficient amount of carbon-dioxide gas, which is heavier than air, can be retained on the surface of the fermenting liquid by placing a small bag of clean sand, about 6 in. square, over the bung-hole. Another method is an air-trap made by fixing a V-shaped piece of glass tubing, having the arms about 6 in. long, into a hole in the bung. The bung is then fixed tightly in the barrel, and the free arm of the tube placed in a glass of water on the barrel. While fermentation continues the surplus gas will escape, causing bubbles to rise in the water, and the air will be excluded thereby. The rapidity with which the bubbles rise will give a good idea of the process of

fermentation, and the cessation of the same will indicate that the action of the ferments has ceased and a dry cider has been produced.

No exact period for complete fermentation can be given—so many factors are liable to influence this, such as the composition of the must, temperature of fermenting-room, &c.

RACKING.

The object of racking the cider is to separate the clear liquid from the lees or deposit formed in the bottom of the barrel. At least two rackings should be made before bottling the cider—the first one when the tumultuous phase of fermentation is over and the cider is fairly clear, and the second before the density is reduced by fermentation below 2° Baumé, or before bottling if it is intended to bottle at a higher density. It is advisable to rack at about half a degree above the degree at which it is intended to bottle, in order to allow for further fermentation between the time of racking and bottling. Supplementary rackings can be employed for clearing the cider and for slowing down and prolonging the fermentation.

A cold, bright day should be chosen for racking. The simplest way to operate is by gravitation, running the cider into a lower cask through a rubber tube used as a siphon. A small cup should be so placed at one end of the tube that the suction will not cause the lees to rise, and the tube then attached to a stick or cane, so that when the stick is introduced into the barrel and the end of the stick is resting on the bottom the tube will be well above the lees. When the barrel is nearly empty the tube can be gradually lowered until the liquid becomes cloudy. A section of glass tubing inserted in the rubber tube, and a light placed behind it if necessary, would greatly facilitate operations.

BLENDING.

As has already been mentioned, a considerable amount of blending is done by mixing different varieties of apples before milling, but only those apples which are in a fit condition to be ground at the same time are blended. Other varieties ripening at other periods are also blended in their turn. It is evident that these different blends will produce finished ciders differing from each other in flavour and their general constituents. The general public do not appreciate these differences, but look for a uniform article when purchasing their cider regularly from the same cellars. To comply with these conditions it is necessary to meet the customer's taste as far as possible by blending the ciders of different periods, so that a uniform cider can be delivered for one year at least. Special blends can also be made to produce a better cider than the bulk, to be sold at a higher price. This naturally calls for a first-class palate and some experience.

The art can also be utilized in small cellars by blending ciders having a preponderance of certain constituents, such as acidity, with ciders lacking in acidity. Care should be taken, however, that none of the ciders to be blended are diseased. A common mistake in this relation is to mix ciders having a vinegar taint with sweet cider in the hope of diminishing the defect, the inevitable result being that the taint is communicated to the whole of the blend.

Blending should be done some time before the cider is ready for bottling, when the Baumé hydrometer records about 5°. The mixing of the ciders stimulates the action of the ferments, and will necessitate an extra racking when the fermentation calms down. For this reason it is useless to filter before blending.

FILTERING.

In commercial cideries it is the practice to filter all ciders directly before bottling, so as to produce a bright uniform article. Several filterings are sometimes necessary to attain this object. The effect of filtering on those qualities which appeal to the palate are disputed. English and German authorities claim an improvement, while the leading French authorities claim the contrary, though they agree that filtering is advisable for ciders which do not clear after several rackings.

There are several types of filters, the filtering-material used being generally cellulose or asbestos arranged in heavily tinned frames or drums. The cider is forced through the filter by hand or a power pump, and does not come in contact with the air. The price of effective filters is unfortunately too high to justify their being employed for filtering small quantities. The old felt bag filters are effective so far as clearing goes, but the process is too slow, and they expose the cider too long to the oxidizing influence of the air and probable infection by vinegar bacteria.

(To be continued.)

SAND-DRIFT AREAS.

THE question of controlling the drift of sand in certain localities on the west coast of the North Island again came before the Board of Agriculture at its meeting this month. After full consideration the following resolution was adopted: "That a new Act or an amendment to existing legislation should be passed empowering settlers to form 'reclamation areas,' with power to elect Boards to administer the same, and with power to levy rates on the land contained within the area under the Board's jurisdiction for the purpose of planting timber-trees and other plants necessary for the creation of forests on sand-drift areas." The Board also suggested that such tree-planting be carried out under the supervision of the State Forest Service.

During the last three years the Forest Service has been carrying out experimental reclamation operations near the Rangitikei River mouth, and very satisfactory results have been obtained so far.

AUSTRALASIAN ANGORA AND MILCH-GOAT BREEDERS' ASSOCIATION.

A GOAT-FREEDERS' association with the above title has been formed in New South Wales. The objects of the association are stated to be: (1) To further the interests of the Angora and milch-goat industries, and the maintenance of the purity of the breeds; (2) to obtain and supply information regarding the character and history of Angora and milch-goats; (3) to protect the interests of goat-breeders. The association's financial year is from 1st October to 30th September. The annual subscription for members is 10s. 6d., and that for associate members 2s. 6d. Associates have the same privileges as full members, with the exception of voting-powers. The honorary secretary of the association is Mr. E. F. Lane, Enalfarn, Burgooney, N.S.W.

SEASONAL NOTES.

THE FARM.

AUTUMN-SOWING OF OATS.

OATS for winter and spring feed and subsequent harvesting should be sown not later than April or early in May. Where they are following a fed-off crop of turnips manure may not be necessary, but on land that has had a crop carted off it is best to use from 1 cwt. to 2 cwt. Suitable fertilizers are mixtures of half superphosphate and half Nauru, Ephos, or a similar phosphate; or 1 cwt. of superphosphate may be applied with the seed and another hundredweight put on as a top-dressing after the feeding-off in the spring. The latter method is good practice after a wet winter when the crop is hanging fire and showing somewhat yellow.

The cultivation for autumn-sown cereal crops should provide a good mould underneath, but an endeavour should be made to leave the surface a little lumpy. These lumps shelter the young plants and prevent the surface from running too tightly together during wet weather; an even surface for harvesting can be provided by harrowing or rolling in the spring.

It is advisable to use oat-seed from the previous year's crop. Some oats, especially Algerians, have a very low germination until the normal ripening process has been gone through. Seed which germinates quite well twelve months from harvesting has been known to give only about 30 per cent. germination a few weeks after harvest. If year-old seed is not procurable and current season's must be sown a very heavy seeding should be resorted to. A normal rate of sowing for Algerian oats is from $2\frac{1}{2}$ bushels to 3 bushels per acre.

LIMING AND TOP-DRESSING.

April is quite a good month in which to apply lime to the land, particularly for grassland that is to get a dressing of superphosphate in the winter. In the case of land intended for cropping the lime should always be put on the ploughed surface; it will work down quickly enough. If applied to a grass surface and ploughed under it quickly gets below the range of the roots of ordinary crops. Most land can benefit from a ton or more of lime per acre, but it is better policy to put on a smaller quantity, say, 6 cwt. or 10 cwt., and repeat at more frequent intervals, rather than put on a heavy dressing and then let it go for several years. There are, of course, exceptions, such as where the land is very sour. In such cases a heavy dressing must be given to show any results. For general purposes, and where it can be applied early in the year, carbonate of lime (ordinary ground limestone) is the best.

Many farmers, especially in the North, are in the habit of top-dressing their pastures in March with the object of producing late feed, though on the whole it is probably better practice to rely on supplementary forage-crops, and to rest the pastures during the winter

months. However, 2 cwt. to 3 cwt. of superphosphate applied now will stimulate a useful growth. The slower-acting manures, such as ground rock phosphate, can be applied with advantage in the autumn with a view to stimulating spring growth.

FEEDING-POINTS.

The feeding of maize, millet, &c., should be finished by the end of April, as the first severe frost cuts these crops back and generally reduces their feeding-value. Moreover, in dairying districts the cows will be drying off about the end of the month, and should go on to hard turnips, swedes, or good pasture. Autumn is the time to feed the cows up and put them in good condition to produce a healthy calf and do their best at the bucket next season. If allowed to go back at this period no amount of extra feeding later in the winter will bring the cow forward in the spring in the best condition. In-calf heifers should also have special care at this time.

The popularity of Japanese millet throughout the Auckland Province and some other North Island districts has been amply demonstrated this season, and undoubtedly many thousands of pounds have accrued to dairy-farmers from its use as a drought insurance. In many cases, however, waste has resulted from allowing the crop to get too far ahead of the stock. Millet is at its best for grazing when about seven weeks old or 8 in. to 10 in. high. The cows then relish it keenly and subsequent growth will be rapid and even. Millet has also proved itself good grazing for lambs, and should be valuable for flushing ewes at mating-time.

As regards the feeding of green crops (barley, oats, &c.), in order to prevent waste from undue trampling of the crop it is better to make two or three feedings-off when the growth is not excessive rather than wait until a large bulk of feed is present. Besides the saving of waste the fodder is more palatable when not too much grown.

IRRIGATION OPERATIONS.

On irrigated areas in Central Otago preparations should now be made to have contour ditches cut, leading water to those places in the various paddocks which during the past season have proved hard to irrigate. This particularly applies to undulating country. Low-lying parts of the paddocks which become flooded during the irrigation season should have open drains cut, so as to allow surplus water to be carried off to lower levels. Ditches can now be cleared while still soft, and all boxes which have become disrepaired during the season should have attention.

The breaking-up of land intended for spring sowings should be pushed on without delay, before hard winter frosts make cultural operations difficult.

SUNDRY HINTS.

Pastures, both permanent and temporary, may still be sown in April, but if the situation is at all exposed it is advisable to sow a bushel of white oats or barley with the grass-seed to provide temporary shelter.

On the better soils probably no better nitrogen-fixer can be grown than vetches, and their importance as a hay crop cannot be too strongly

stressed. The crop, whether for seed or for hay, should be got in by April. Oat and vetch hay is highly palatable and relished by stock. Rates of sowing were given in last month's notes.

Where necessary preparation for drainage should now be made. The levels can be taken and the lay of drains determined, so that when time permits the actual work may be carried out. The mouths of all drains should be also attended to and put in good running-order before winter sets in. It is a good plan for a farmer to have a sketch of his farm, showing each field, and where watercourses and drains are situated.

In all cases stacks should be raked and made secure, and when not intended for immediate use they should be thatched. Where not already done stacks should also be fenced without delay, as stock will be acquiring a keener appetite for dry fodder, and can do a considerable amount of damage in a short space of time.

The tripod-harrowing of cow pastures at this time of year allows the solvent action of the rain to make available a well-distributed and valuable manure.

—*Fields Division.*

THE ORCHARD.

MARKETING.

THE principal work to be undertaken by the fruitgrower is the gathering of the later varieties of apples and pears. By the time these notes appear stone-fruit will be practically finished, while apples and pears will continue for a considerable time yet.

Each variety as it develops and matures should be dealt with. Every grower should have a clear idea of what he is going to do with his fruit before he gathers it. The reason for this is obvious, as it will in many instances determine the time for picking. Where midseason varieties of apples are required for local markets they should be allowed to reach the full maturity stage previous to picking. If this is done the fruit will practically always command a good price; whereas if fruit is picked before it has reached that stage of maturity when it gives the best flavour and presents a good appearance it will suffer in value. It is always well to bear in mind that the expenses of marketing are practically the same for both classes of fruit; therefore the grower should aim at securing the maximum return for his labour by marketing his fruit in a proper manner. When fruit opens up in the pink of condition it sells itself, whereas when it is in poor condition it is hard to sell on any market.

AUTUMN SPRAYING.

Where woolly aphis is very bad no time should be lost in spraying for its control, using either Black Leaf, 40, 1-800, plus 3 lb. soap to every 100 gallons, or red oil, 1-60. In some localities, should the weather conditions continue dry, it may still be necessary to make a late application of arsenate of lead for the control of codlin-moth and leaf-roller caterpillar. There is always a danger of leaving off this spraying at too early a date, a late infection being the result.

COVER-CROPS.

Where cover-crops are required and have not been sown no time should be lost in having the work carried out, as the growing-season will soon be past. Lupins, peas, and vetches all make good crops for ploughing-in. This is a splendid way of adding organic matter to the soil where it is lacking.

PLANTING.

Where planting is contemplated during the coming winter there should be no delay in ordering the different varieties required, as it is often difficult to obtain them later in the season, and often much dissatisfaction and inconvenience is caused, whereas by a little forethought this could have been obviated. It is also well to remember that land needs to be thoroughly prepared beforehand if the best results are to be obtained. An early start should therefore be made by ploughing up the land for the first time, which will give an opportunity for all growth to decay. The soil will also be sweetened by this process, and will be in a much better condition to receive the trees than if ploughing is left until the winter. In some localities planting can be done (given suitable weather and soil conditions) towards the end of May or early June. However, unless conditions are very favourable it is better left till about August.

—L. Paynter, Orchard Instructor, Christchurch.

CITRUS-CULTURE.

There appears to be every indication that the autumn blossoming will be below the average, but slightly earlier than is usual. Immediately the blossom petals have fallen from this blossoming it will be necessary to put on an application of bordeaux, 4-4-40, for the control of fungoid diseases generally. Where *Lecanium oleae* (brown scale) is still causing trouble on citrus-trees a further application of red-oil emulsion, 1-40, may be applied about three weeks after the bordeaux is put on. As pointed out in previous notes, high-pressure power is most essential for the successful carrying-out of this work, as the citrus-trees require very careful attention if they are to be efficiently sprayed. Too little attention appears to be paid by some growers to the destruction of infected fruit—that affected by verrucosis, brown-rot, or blue mould (*Penicillium*). On no account should this diseased fruit be allowed to lie about in or around the orchard; it should either be completely removed, or buried to a sufficient depth to preclude the possibility of the spread of spores from it.

FIREBLIGHT.

Owing to autumn weather having set in considerably earlier than is usual it is not considered likely that there will be any further infection of this season's growth from fireblight on either apples or pears in the Auckland District. As previously stated, the position is entirely satisfactory at the present time, as far as those areas situated within the boundaries prescribed by the Fireblight Act, 1922 (Second and Third Schedules), are concerned.

—J. W. Collard, Orchard Instructor, Auckland.

POULTRY-KEEPING.

MANAGEMENT OF THE PULLETS.

PULLETS should now be in their permanent winter quarters, especially birds that are nearing the laying-point. Changing of the quarters at this stage is a common cause of the birds going into a moult with the adult flock, thereby causing a loss of winter eggs. Any sudden change of food will also have this undesirable effect.

It will thus be seen that uniform treatment in all things pertaining to the management of the pullets at this period of the year should be the watchword of the poultry-keeper. On no account should pullets be forced to prematurity with rich foods such as meat, milk, &c., until good bodily development has been attained. At one time it was a commonly held opinion that the bird to mature first was the most profitable to keep, but this does not hold good to-day. It is common to hear breeders boasting that their particular strain of birds commence laying at four and a half to five months old, and sometimes younger. This may be quite true—indeed, I have known of pullets that started to lay before they reached four months. But of what advantage is this when nothing but a second-grade egg can be expected from them? Besides, such stock are next to useless for breeding purposes by reason of being undersized, which necessarily goes hand-in-hand with prematurity. To force a pullet to prematurity is about as sensible as the common practice of breeding from specimens that are devoid of breed-type and producers of small eggs, merely because they have some ancestral egg-record strain behind them.

THE SIZE OF EGGS AND BREED-STANDARDS.

As things point there is every prospect of the Dominion establishing a sound overseas trade in eggs. To achieve this nothing less than a 2 oz. standard egg is required, and it is not the altogether-too-commonly-seen diminutive White Leghorn than can be depended upon to produce this desirable exportable article.

It is commonly agreed by old fanciers—the men whom we have to thank for developing the breeds of poultry at our command to-day—that the good big bird is always better than the good small one. True, the fanciers (and perhaps more so the judges) often made mistakes by aiming for birds of extreme size and those possessing exaggerated show points, such as heavy combs, long legs, loose feathering, &c., at the expense of the egg-basket. Unfortunately, however, too many utility breeders are going to the extreme in the other direction. While the great merit of many strains of White Leghorns we possess is undeniable, still there is a tendency for the average flock to become smaller and smaller each year, as well as the eggs they lay. In addition there is a general lack of breed-type.

I have long contended that striving for heavy egg-yields and ignoring breed-type and general standard requirements would ultimately bring about the ruination of many strains. This contention was fully borne out by the fact that the bulk of the eggs which came forward for the recent trial export shipments failed to turn the scale

at 2 oz. In view of this it has been suggested that the 2 oz. standard is too high, and that a grade for $1\frac{3}{4}$ oz. should be established. The argument used in support of this is that too many small eggs have to be handled in order to select sufficient of the 2 oz. product. Of course, this is a weak argument in view of the fact that a name for New Zealand eggs has been made on the London market by the initial shipment of 2 oz. eggs. The proposal, indeed, suggests itself as trying to foster the industry on the one hand and to kill it on the other. In a general way the $1\frac{3}{4}$ oz. egg would cost as much to land on the London market as the 2 oz. one. The freight, the case, the fillers, &c., would be about equal in cost. Thus by shipping the lower-grade article a non-payable price would probably be returned to the producer, to say nothing of the risk of losing the good name we have already established.

Rather than lower the grade the poultry-keeper should mend his methods of breeding and management, so that at least the great majority of his flock will produce 2 oz. eggs, a size which is so much desired on the London market. Just as the number of eggs can be increased by careful breeding and selection, so can the size of egg be increased by the same process. Of course, the man with a small-egg flock is in a happy position so far as the local trade is concerned, as under the present crude system of pooling he gets a similar price for his $1\frac{3}{4}$ oz. eggs as the man with a 2-oz.-producing strain. In the latter size there is practically 3 oz. more food in each dozen—in other words, a difference of one and a half 2 oz. eggs to the dozen. Thus it will be seen that the consumer invariably, if not always, pays too much for small eggs and not enough for large ones. On the London market it is entirely different. Eggs are paid for according to their weight and quality, and the sooner this is realized by the producer the sooner will our export trade be placed on a sounder footing. The small-egg question is one of the most important problems facing poultrymen to-day. Utility poultrymen generally will be well advised to give more attention to the maintenance of breed-type than hitherto.

Reference has again and again been made in these notes to the value of poultry shows as a means of preserving the correct type of the various breeds at our command. The illustrations in the Dominion Utility-poultry Standards afford a splendid guide as to the best types to breed from for the production of uniform flocks, and which can be depended upon to lay the standard weight of egg so much desired for the overseas trade. With the prevailing tendency I can see a great revival of the type aimed at in the Utility-poultry Standards, as well as a general realization that poultry shows are of equal importance for the welfare of the industry as are the egg-laying competitions—the one being a corrective of the other. Beauty and utility are not inseparable, but in the absence of show competition this fact is apt to be ignored if not lost sight of altogether.

While the striving after extreme egg-production has reduced the value of many strains of White Leghorns by bringing about deterioration in size of fowl and egg, it is gratifying to know that there are still strains in the Dominion which retain the needed size, stamina, and power to produce good numbers of first-grade eggs. The warning, however,

is there that there is a limit to which we can go in the laying-capacity of a bird, and if phenomenal layers only are looked for the strain will suffer in constitutional vigour and size of bird and eggs.

LEG-WEAKNESS IN YOUNG STOCK.

Many complaints have reached me of young birds developing a weakness in the legs, and in each case the cause has been traced to too close confinement accompanied by very liberal treatment. There is here a close analogy to the hothouse plant—a rapid development but lacking in substance. For the maintenance of a healthy, vigorous flock it is essential that the young stock should be reared in the most natural manner possible, without, of course, subjecting them to extremes of weather. This implies good comfortable housing. In addition they should be fed well from first to last. There is, however, always the risk that this needed care may unconsciously develop into pampering, and the coddled bird is a menace. Plenty of fresh air and exercise will always be the fundamental requirements in raising heavy-producing stock. The modern high-type layer is an artificial product, but if she is to be bred to the profitable standard to which human wit and experience have brought her the demands of nature must be observed. The higher the type of the animal the greater is the need to provide against the weakening influences of close confinement and lack of exercise.

—F. C. Brown, *Chief Poultry Instructor.*

THE APIARY.

PREPARATION FOR WINTER.

THE time is at hand when it is of paramount importance that proper preparation be made for winter. If the colonies are to winter in good order, so as to escape the abnormal losses which sometimes occur, then it behoves the beekeeper to attend to the leading factors that produce successful wintering. The attendant evils of neglect are starvation, spring dwindling, and poor colonies, these latter being of little account when the next season's flow arrives.

Among the most important factors which make for success are a strong cluster of bees, a good queen, plenty of good stores, and protection. It is safe to say that too little attention is paid to wintering the colonies with strong clusters of young bees. Having secured a crop of honey, and noting that the colonies are strong in bees, the beekeeper is satisfied to trust to chance. At the close of the season the colonies are likely to contain a large force of bees, but the majority, having helped to gather the season's crop, are old, and in consequence cannot be taken into account in wintering. As a result, unless large numbers of young bees are being raised to take the place of the old bees, the colonies will seriously dwindle in the spring or become a total loss in the winter. Every effort must be made to keep up breeding well into the winter, and it is often advantageous to stimulate the colonies by autumn feeding.

Next in importance is the necessity for the colony to be headed by a good queen. Too little attention is paid to superseding failing queens. A queen that has laid vigorously during the honey season is likely to become worn out and her powers of reproduction diminished. In all cases these queens should be replaced and a vigorous young mother supplied. It often happens that the bees recognize a failing queen, and set to work to supersede her, but this work should be anticipated by the beekeeper. Other things being equal, stocks headed by a vigorous mother are likely to keep up late breeding, with a result that the colonies will come out in the spring with a prolific queen, and the loss attendant upon queenless hives will be greatly diminished.

If the beekeeper studies his interests and the welfare of his bees he will ensure that every colony goes into winter quarters with plenty of good stores. This is a most important factor, and upon it depends largely the staving-off of starvation which faces the bees during the months which follow. The colonies that are supplied with honey winter safely, build up early in the spring, and are ready to take advantage of the nectar from the early-flowering plants. Beginners often ask how much honey should be left for the bees to winter on. The amount necessary must to some extent depend largely upon locality, and care must be exercised, more particularly in the South, to provide sufficient food so that winter feeding may not have to be resorted to. In the North winter feeding may be successfully carried out, as there is not the same risk in breaking up the clusters as there is in the extreme South. As mentioned last month, in no case should a colony be left with less than 30 lb. of sealed honey, and it is wise to increase this amount to 40 lb. Abundance of stores is essential if winter losses are to be eliminated altogether.

Another important factor in safe wintering is that of protection. This may be provided by housing the bees in good watertight hives and protecting them by good shelter-hedges or fences. Great winter losses occur every year in this country through lack of attention to the hives, more particularly to the roofs. Leaky roofs are an abomination, and should not be tolerated under any circumstances. By allowing the roofs to leak the mats and hives become damp, and the consequent drain on the stores is largely in order to keep up the heat of the cluster for safe wintering. It is safe to state that where the bees are kept dry the amount of food consumed to keep up the heat of the cluster will be small as compared with the stores eaten where proper protection has not been afforded by the beekeeper. New Zealand in general being a wind-swept country, it behoves the beekeeper to see that the bees are located in a sheltered position. Cold winds militate against brood-rearing, and also prevent the bees from taking a cleansing flight during the spring months.

MARKETING THE CROP.

Before the honey is finally run out of the tank the beekeeper should have decided on which market he intends to place his product. If export is his aim the matter is comparatively simple, as only large packages are required; but where the local trade is to be catered for it is wiser for the beekeeper to put the honey up into small packages

himself. Rehandling means remelting, and unmelted honey is the better article. In addition, if the honey is not to be sent overseas the producer owes it to himself to sell it under his own name and trade-mark. This will soon prove the best form of advertisement, and, coupled with a reputation for care and cleanliness, should ensure quick sales and good prices.

Everything should be done to make the article as attractive as any other food product, and proportionately as much care given to the intricate result of beekeeping as to the bees themselves. The Sale of Food and Drugs Act requires the honey-producer to label his packages and to state thereon the contents and weight. Apart from this requirement being a necessity as representing a fair deal with the consumer, it has also done good work in disposing of old-time haphazard methods of marketing, and has helped to force on beekeepers the necessity of studying the commercial side of the industry.

CARE OF COMB HONEY.

There are factors in the proper treatment and care of comb honey which the producer is apt to overlook when putting his honey on the market. Usually the practice followed is to despatch the crop to market, where it is sold, to be afterwards graded and cleaned by buyers who are alive to the demands of the local market. These buyers obtain a better price by grading and cleaning the comb honey, whereas the producer can by employing proper methods demand an increased price.

Comb honey should be fully capped before removal from the hive, and it should not be left until its white appearance is destroyed by travel-stain, this being caused by the constant traffic in the hive. When the sections are removed they should be stored in a warm, dry room, as low temperatures hasten granulation, and granulated comb honey is not likely to meet with ready sale. Moreover, comb honey stored in a cold, damp place is apt to "weep" (or absorb moisture from the atmosphere), forming beads on the surface of the comb, which in the course of time becomes sour, thus destroying its marketable value. As opportunity allows, the sections should be cleaned of all propolis and stain; this is best done by scraping the sections with a knife, and the operation finally completed by sand-paper. Care must be exercised not to damage the cappings of the comb and thus destroy its attractiveness.

Before forwarding the honey to market it should be carefully graded, and finally packed in cartons. By the use of cartons the sections are secured from dust and insects, and present an attractive appearance when offered for sale, besides being far less liable to breakage. In order to ensure safe transit excellent shipping-cases can be purchased from the hive-dealers. These cases are fitted with corrugated paper cushions, which materially reduce the breakage from rough handling. A feature of these section crates is a sliding-cover which enables the honey to be readily examined. The crates are appreciated by the retailers, and at the same time help to increase the average price to the producer.

—E. A. Earp, Senior Apiary Instructor

THE GARDEN.

VEGETABLE-CULTURE.

HARVESTING and storing the crops will be important work during April. After the dry summer experienced in most localities the potato-moth is likely to be troublesome. Its depredations will be prevented to a large extent if care is taken to bag up all potatoes dug each day, and so avoid leaving any on the ground overnight on which the moth may deposit its eggs. Potatoes that have grown near the surface of the ground are likely to be infected, in which case they should not be placed in the bags with sound tubers.

The most serious losses in this and other crops are the result of storing mixed grades. It is of first importance that only a perfectly sound sample should be put aside for long storage. All defective, broken, and small types should be graded out for immediate use. The best storage conditions for tubers and the like are those which exclude moths and vermin, that are dark and with an even temperature and ordinary atmospheric humidity. Under such conditions if the product is ripe and well harvested there will be only small losses.

Cabbage, cauliflower, and lettuce plants sown in the previous month should now be planted out on a piece of clean well-prepared land in an open situation.

Celery should be earthed up as advised last month where this operation has not been completed. In a sheltered well-drained situation form seed-beds of main-crop cabbage, summer and autumn cauliflower, onions, and lettuce for planting out in early spring.

SMALL-FRUIT.

After the preparation of the land it is most essential that strong clean plants be planted. Raspberry-canecaners are sometimes obtained from a nearby grower. Before definitely placing the order it is well to visit the plantation and see that the canes offered are, as mentioned, clean and strong. Currants—black, red, and white—are in fair demand, as also are gooseberries. Intending planters are recommended to carefully go into the question, and place their order early where satisfactory plants can be obtained.

While it is necessary to avoid working the land when it is wet, the opportunity should be taken, whenever the land is dry, of putting the hoe through these sections, more especially the newly planted strawberry-beds.

THE HOME SURROUNDINGS.

The present is a suitable time to attend to the trimming of hedges, clearing open drains, and gravelling paths—attentions that go a long way towards enhancing the comfort and appearance of a garden. The garden hedge is usually allowed to grow too wide and top-heavy. It has a better appearance if kept narrow, and the top a little more so than the base.

In the warmer situations new lawns will come away very quickly; while it is undesirable to let the new grass get too long, it is still less

desirable to cut it too short. Occasional attention with a mower that is sharp, properly adjusted, and set high is the best treatment at this season.

The time is now approaching when the planting of evergreen and deciduous trees and shrubs may be carried out. One often sees expensive and beautiful trees planted that fail to grow, or should they grow the results are disappointing—a result that is usually due to an unsuitable environment. Successful effects are readily obtained if the local conditions are studied, together with the conditions preferred by the different shrubs. For example, a house on a sandhill in a locality with a low rainfall is a most discouraging site for a garden; yet there is a local instance in which by means of concrete paths, ice-plants, cacti of many different kinds, and the popular *Romneya Coulteri*, &c., a flourishing, beautiful, and curious garden is the result. Every plant there is a native of such conditions, and requires little encouragement to make it flourish. On rather hilly country with an acid soil rhododendrons, azaleas, heaths, and such plants flourish naturally, and will give effects unequalled by similar plants elsewhere. It is from this point of view that the planter should usually study the subject, for where this is done not only is the garden approved, but it also harmonizes with the outside environment.

—W. C. Hyde, *Horticulturist*, Wellington.

HIGHLY GROUND NAURU PHOSPHATE.

At the meeting of the Board of Agriculture this month the President informed the Board that it had come to his notice that some top-dressing experiments with very finely ground phosphate rock derived from Nauru and Ocean Islands were being carried out in Victoria, with good results. He had been able to secure a sample of this finely ground material which was submitted to the Department of Agriculture and reported upon by the Department's Chemist, Mr. B. C. Aston. The latter advised that the phosphate rock was ground very finely indeed, having passed through a mesh 120 to the linear inch, and as a result it was in a more available form than the ground Nauru phosphate usually on the local market (100-mesh). It is proposed that the Department shall carry out some experimental work in the Dominion with similar highly ground material.

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 1st March: *Peas.*—Arrivals of Japanese blue continue heavy and spot market is somewhat depressed. Japanese on passage have been sold at £21 10s. per ton c.i.f.; February–April shipments, £22. Tasmanian blue offered at £20 c.i.f., February–March shipments, but buyers' idea about £19 10s. New Zealand blue, slow sales for spot at £17 to £19. New Zealand partridge worth about 75s. per 504 lb. c.i.f., but sellers asking 77s. 6d. for March–April shipments. Maple ex store at nominal values; Tasmanian, 90s. to 95s.; New Zealand, 73s. to 75s.; Tasmanian afloat, sellers 90s., buyers 87s. 6d.; February–March shipments, sellers 86s. 6d., buyers 85s. *Beans.*—English old winter crops sold up to 56s. per quarter; spring crops, 65s.

New Rabbit District.—The constituting of the Kihikihi Rabbit District (South Auckland) for the purposes of Part III of the Rabbit Nuisance Act is gazetted.

THE HAGUE INTERNATIONAL CONGRESS ON CATTLE-BREEDING, 1923.

THE International Congress on Cattle-breeding convened by the Netherlands Government, and held last year at the Hague, was attended by some 155 delegates representing thirty-six different countries. The proceedings largely covered the field of stock-breeding and feeding generally, while the subject of tuberculosis among cattle was also dealt with. New Zealand was represented at the Congress by Mr. R. McGillivray, of the Department of Agriculture, who was at that time in Europe. The following matter is from a brief report furnished by Mr. McGillivray :—

The Minister of Agriculture (Hon. C. J. M. Ruys de Beerenbrouck) opened the Congress, and emphasized the point that in almost all countries stock-breeding forms an important source of revenue, and the national prosperity is closely allied to this branch of agriculture. In all parts of the world competent persons are engaged in breeding stock, and many of these apply scientific knowledge, but still we find we are to-day to a very large extent working in the dark, and much remains to be done before we can hope to attain that measure of success that is desirable.

The object of the Congress was stated to be to bring together representatives from the principal agricultural countries of the world for the purpose of obtaining an exchange of views and ascertaining the various methods of breeding, feeding, &c., in the different countries. It was felt that now that world relations have become somewhat normal and meetings of an international character are possible, it is a matter of very great importance that the scientific currents that have developed in the different countries, in the stock-breeding sphere, should run concurrently, so that in this way the views of each should be tested, and that there should be a general exchange of ideas. It was very noticeable that this Congress was not one in which certain delegates came full of ideas and theories which they were anxious to impart to their fellows. The feature of the sessions was the fact that all seemed to be searching for information, and seeking means to turn aside the veil of mystery that enshrouds some of the fundamentals of the art of breeding.

The statement was made that breed-improvement is now at something approaching a dead end, because there are comparatively few men who fully understand the art of breeding even as at present recognized, and that being the case many are inclined to leave further breed-improvement alone. It was pointed out that even supposing this to be true, there are in all countries successful breeders and scientific men whose services are available as research workers. Many of these may not be fully experienced, but if we fail to make use of the human material at command in a case like stock-improvement, where, speaking broadly, little is known, then the world may wait for centuries before the intricacies of breeding emerge from their present obscurity. Encouragement should be given to all workers, and thus the spirit of progress will be kept alive.

It was pointed out that there can never be such a thing as absolute perfection of type. In the past a system of inbreeding aided by careful selection has given us the stock we have to-day. Breeders in most cases simply set up a standard and mate stock accordingly. We have now, however, reached a stage when deep delving into the laws that govern inherited characters is necessary, and, as mentioned at the Congress, this can only be done under something approaching experimental farm or college conditions. It is a slow and costly undertaking which can be carried out only at a State or an endowed institution.

It was mentioned that the organization of research in Great Britain as applied to agriculture may be said to date from the appointment of the Development Commission, in 1909. Prior to that date agricultural research was unrecognized by the State. If this research movement is to be kept alive it must continuously be kept in contact with the business of farming. To divorce

research from the farm and the farmer is to cause the farmer to lose faith in scientific investigations. He must be kept advised by means of progress reports as to the work in hand and results obtained, and their practical application to the farm.

It was pointed out that selection in breeding signifies nothing else than making use, in practice, of the laws of nature with regard to heredity. Ample knowledge of the results of the laws of heredity that have been recorded is therefore of especial significance for the breeder of stock, and the utmost importance must be attached to the results of investigations with respect to heredity as set out in the mutation doctrine according to de Vries, and also the teachings of Mendel and other investigators.

What is known so far concerning mutation shows us the extraordinary importance of the single individual in selection, and the necessity of determining its breeding-value by means of the progeny and their performances. Mendel has shown that every factor of heredity behaves, in the process of heredity, perfectly independently, and that, on crossing, the introduced hereditary factors in the succeeding generations are subject, according to fixed laws, to a splitting-up process. It is the generally accepted idea that it is not the type of animal as such that is inherited. The disposition of characteristics does not form one whole in the process of heredity, but the separate factors take their own course. The doctrine of heredity has an exceptionally lasting influence upon the mode of thought and outlook of the breeder, and upon the judgment of the results of breeding.

The views of the Mendel doctrine give the breeder valuable general particulars and points upon which to go in carrying on selection in breeding; but knowledge concerning the nature and the conduct of the definite factor of heredity is still a matter of pure surmise, and therefore it is recommended that further research on this point be undertaken.

It is in the interests of the economic breeding of domestic animals to investigate in all directions the question of heredity by supporting new or established institutions for biological research, and herd-books should be available for investigations of heredity. The analysis and investigation of the characteristics of heredity in our breeds of cattle must be based primarily on the particulars contained in the herd-books. As the desire for breed-improvement is world-wide it is therefore desirable that herd-books should be compiled according to a common international plan, so that particulars from individuals should be similar irrespective of location.

For the purpose of breed-improvement close co-operation is necessary between science and practice. Science must develop the particulars ascertained from practice, and practice must reciprocate and thus pave the way for the success of both.

The breed societies should have registered all animals that do not deviate from the race, and the breeding results should be available to breeders. The organization and holding of fairs and shows should not be considered so much as a competition, but more as a means of gaining experience and educating the people. Efforts should be made to ascertain the external circumstances that exercise an influence upon the development and retention of characteristics in domestic animals.

In considering how public authorities could assist in promoting stock-breeding Dr. Attinger (Germany) mentioned that in all civilized countries such breeding enjoys State encouragement, and it might also be said that the height of the development of stock-breeding is a standard for judging the civilization of a nation. In this connection it was pointed out how intimately connected were the cultivation of crops and stock-breeding, as without pastures and fodders no stock could exist. It was therefore necessary for stock welfare that fodder-crop development should receive public encouragement.

The establishment of Government model breeding-farms was advocated for the purpose of developing good stock, as it was a fact that mongrel stock were in all countries a source of serious loss. Such model farms should be quite independent of the ordinary State experimental farms, and should not be set up in a manner which could not be emulated by breeders, but the establishments

as regards equipment, manner of working, and profit-making should be examples capable of being followed by all breeders.

The task of model breeding-farms would be to produce choice strains of stock with hereditary qualities on such conditions as are most suitable to their perfect preservation. In proportion as the individuals of the male line from these choice strains become available they should be placed at the disposal of farmers' societies, and if this were done the "scrub" bull could in a comparatively brief period be eliminated by legislative action.

In the session dealing with the science of feeding it was apparent that eminent scientists like Professor Mollgaard, of Copenhagen, and Professor Isaachsen, of Christiania, were very far from satisfied with the present position and knowledge regarding animal nutrition. It was said that in countries where pasturage is available for seven or eight months in the year it is doubtful if the matter of animal nutrition as placed before the agriculturists of the colder lands of the earth will ever be seriously considered, for good pasturage is the best and cheapest food that can be given to stock, and if plenty of suitable fodder-crops are grown in the climatically favoured countries for use when the grass is not abundant, it is likely that this would fully meet the need without the use of expensive concentrates of often doubtful quality. It was also mentioned that many of the theoretical feeding experiments and results obtained have utterly failed to work in practice.

It was, however, the desire of the Congress that the work of investigation in this branch should be encouraged as far as possible.

The session devoted to tuberculosis among cattle—one of the most serious problems confronting breeders in Europe—was of a very interesting nature. The significance of the disease lies in its great prevalency, and in the fact that it hinders the economic use of many animals and costs immense amounts of money every year. The cattle-breeders are now favourable to and realize the necessity for measures being taken against the spread of the disease. The Congress appeared favourable to the principle of legislation granting payment of compensation for animals destroyed, but owing to the prevalence of the disease in some countries did not consider the time opportune to take the matter up.

It was held that for the promotion of greater security for stock-breeders, and in the interests of the production of clean milk, a continuous effort is necessary having for its object the reduction of tuberculosis to the very smallest possible proportions. Irrespective of other considerations prompt measures must be taken for the eradication of infection-distributors. The use of tuberculin not only facilitates the campaign against the disease, but is indispensable.

Though the virulence of the bovine tuberculosis bacilli is very great in cattle, and it has been found that susceptibility to tuberculosis increases correspondingly with the development of breeding for milk-production, still it is satisfactory to know that many herds of heavy milkers are quite free from the disease. It was pointed out that even in regions where the disease is extremely common only from 0.3 to 1 per cent. of new-born calves are affected with congenital tuberculosis. In order to avoid infection healthy animals must not be allowed to remain in contact with diseased ones, and raw tuberculous milk must not be fed to animals.

FORTHCOMING AGRICULTURAL SHOWS.

Mayfield A. and P. Association: Mayfield, 22nd March.

Methven A. and P. Association: Methven, 27th March.

Temuka and Geraldine A. and P. Association: Winchester, 3rd April.

Manawatu and West Coast A. and P. Association: Palmerston North (Winter Show), 17th, 18th, 19th, and 20th June.

(Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.)

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

MORTALITY AMONG PIGS.

E. P., Waituna West :—

Some of my pigs have died, and may have eaten some phosphorized pollard or poisoned rabbits. On examination I could not find any pollard or smell any, but a little smoky gas came out of the stomach. The fluid in the gall-bladder was just like iodine. When dying, the pigs panted but would not drink, and when dead became blotchy. They had been fed on sour milk and allowed to graze; the weather was very hot. Kindly advise me if the above symptoms point to pollard poisoning or some other malady that is fatal to pigs.

The Live-stock Division :—

Judging by your letter we should say that your pigs did not die as the result of phosphorus poisoning. The smell of phosphorus should be quite distinct on opening the stomach, and if opened in a dark room the phosphorescent glow is immediately noticeable. The symptoms of phosphorus poisoning are evidences of pain, increased thirst, and vomiting and diarrhoea, followed by collapse and convulsions. The pig is particularly liable to digestive trouble if improperly fed, and the skin is readily affected, getting a blotchy appearance such as you describe. Your method of feeding seems to be unsuitable, and was probably the cause of the mortality.

DRAUGHT OF PLOUGHS.

A. J. TROTTER, Hillgrove :—

Could you please inform me which plough is the lighter draught—the New Zealand or the American type?

The Fields Division :—

The draught of a plough is not very materially affected by the shape of the mouldboard. In the case of the American type of plough the furrow is cut and lifted and then shovelled over, giving a pulverizing effect. The colonial type with the long mouldboard gives resistance for a greater length of time, and finally a packing result which increases the friction. The difference may be aptly expressed by the fact that a short-mouldboard plough wears first on the breast, while a long mouldboard wears at the end of the board. The general opinion among experienced ploughmen and trade experts appears to be that there is little difference in draught between the two types, but that, if anything, the American is lighter.

FOWLS WITH FOOT TROUBLE.

M. B., Weraroa :—

Could you tell me the reason for fowls getting large red cushions between their claws, and the cure? I have also a young Wyandotte which has the same higher up on the leg.

The Chief Poultry Instructor :—

Your birds appear to be suffering from corns. The chief cause of these is due to continuous hard pressure. High perches and a hard floor to alight on are a frequent cause of the trouble, while stony runs or pricks from thorns often bring it about. The perches should not be higher than 15 in. from the ground, and there should be ample litter on the floor. Prevention on the lines indicated is the best

way of dealing effectively with the trouble. As to the affected birds, I would recommend that they be not allowed to perch, and that they be provided with a soft bed of straw to sleep on. Painting the foot with iodine is a simple and often effective treatment. Repeat this daily for a week, while frequent dressings of vaseline should be applied, especially to the sole of the foot, in order to keep it soft, this being the place at which the trouble usually starts.

BURNING OFF DANTHONIA.

E. E. V., Waiotapu :—

Please advise as to the best season for burning off danthonia, tussock, &c.—that is, the season when the fire will do most good to the pasture and kill any scrub growing in it.

The Fields Division :—

The best time to burn danthonia is in mid-autumn, so as to secure a good palatable bite throughout the winter. At one time burning danthonia at this season was regular, but many experienced farmers now practise in autumn and winter heavy cattle-stocking of danthonia that has got away. This leaves the country good for sheep in the spring. If the land has much bracken on it late autumn burning should always be carried out, but where manuka is springing up it is often better to burn in September. Unless, however, the land has been understocked during the winter it will not fire readily in spring.

BURNING OF IMPORTED HAY, STRAW, OR CHAFF PACKING.

THE following regulations under the Stock Act, dealing with hay, straw, or chaff packing received in connection with goods imported from certain countries, were gazetted on 6th March and came into force on the same date. They are designed as an additional precaution against the introduction of stock-diseases into New Zealand.

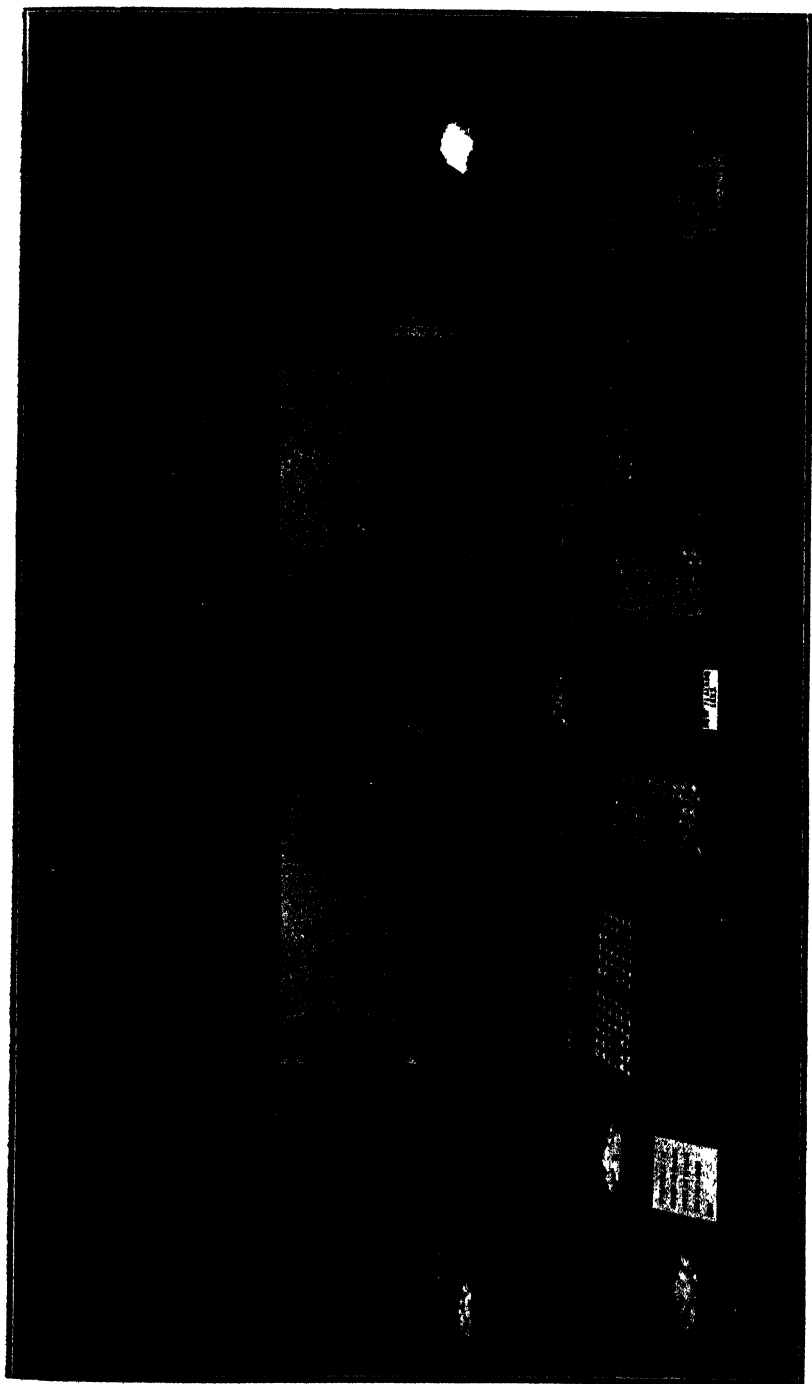
REGULATIONS.

1. In every case where goods of any kind are imported, either direct or by way of any other country, into New Zealand from Great Britain, Ireland, or any part of the Continent of Europe, or from the States of Queensland or Western Australia in the Commonwealth of Australia, or from the United States of America, and where any hay, straw, or chaff is received with such goods as packing or otherwise, the importer of such goods shall, with as little delay as may be, and in any case within three days of the commencement of the unpacking of such goods, thoroughly destroy all such hay, straw, or chaff by burning :

Provided that in the case of hay, straw, or chaff used for packing goods manufactured and packed in Great Britain the destruction of such hay, straw, or chaff will not be required if the packages are accompanied by a sworn certificate or statutory declaration from the exporter or packer, countersigned as correct by a responsible officer appointed by the High Commissioner for New Zealand for the purpose, to the effect that the hay, straw, or chaff used for packing had been disinfected prior to use, by steam, at 185 degrees for ten minutes, or by some other effective method approved by the High Commissioner.

2. In no case shall any importer use or suffer to be used any such hay, straw, or chaff (unless accompanied by a sworn certificate or statutory declaration of disinfection, countersigned as correct as provided for in clause 1 of these regulations) for repacking the same goods or for packing any other goods.

3. Every person who commits a breach of these regulations shall be liable to a penalty of not less than £2 nor more than £20.



STREET-WINDOW DISPLAY OF NEW ZEALAND EGGS FROM FIRST COMMERCIAL EXPORT SHIPMENT, AT HIGH COMMISSIONER'S OFFICE, STRAND, LONDON, NOVEMBER, 1923.

WEATHER RECORDS: FEBRUARY, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

RETURNS to hand show that, with the exception of Canterbury, the rainfall in February was mostly somewhat above the average for the month in previous years. There were few atmospheric disturbances of much intensity or long duration. The month opened with a small westerly storm, but this was followed by anti-cyclonic conditions which prevailed for nearly a fortnight over the North Island. The latter part of the month was more changeable, owing to influences outside the Dominion. There was great warmth and high humidity, which conditions, rather than barometric changes, accounted for the rains that proved so generally beneficial to the country, especially about the middle of the month. The rainfall was often of a scattered or local character, probably owing to electrical conditions. Thunderstorms of note were reported in Southland, and accounted for some local rainfalls on the 12th and 15th. The dryness of the soil and the suddenness of the downpours prevented the rain soaking in, and left the country still in need of more moisture. Two westerly depressions also passed in the South on the 20th and 23rd, causing gales and rain. The same systems, however, were responsible for the nor'-westers in Canterbury and other parts of Otago.

—D. C. Bates, Director.

RAINFALL FOR FEBRUARY, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average February Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitaia	5.54	7	2.84	2.95
Russell	2.44	9	1.15	4.35
Whangarei	4.73	10	1.42	4.95
Auckland	4.78	11	1.62	3.02
Hamilton	3.69	14	1.25	2.85
Kawhia	2.96	7	1.20	2.40
New Plymouth	4.46	9	1.64	4.09
Inglewood	7.56	10	2.42	6.30
Whangamomona	5.43	7	2.79	4.14
Tairua, Thames	2.72	7	1.70	4.52
Tauranga	2.93	7	0.97	3.73
Maraehako Station, Opotiki	5.40	12	1.72	3.70
Gisborne	1.83	8	0.72	3.68
Taupo	4.18	9	2.52	2.81
Napier	1.12	5	0.55	2.56
Maraekakaho Station, Hastings	1.69	3	0.93	2.52
Taihape	3.94	7	1.66	2.43
Masterton	3.92	7	1.84	2.71
Patea	5.10	8	1.72	2.33
Wanganui	3.32	5	1.97	2.49
Foxton	4.93	9	1.98	1.71
Wellington	4.24	10	1.76	3.18
<i>South Island.</i>				
Westport	5.97	12	3.05	4.37
Greymouth	5.12	12	1.05	6.13
Hokitika	5.48	17	1.38	7.20
Arthur's Pass	8.61	6	3.21	7.55
Okuru, Westland	9.40	14	1.80	7.92
Collingwood	11.55	10	3.82	5.63

RAINFALL FOR FEBRUARY, 1924—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average February Rainfall.
<i>South Island—continued.</i>				
	Inches		Inches.	Inches.
Nelson	3·27	10	1·60	2·80
Spring Creek, Blenheim	2·84	6	1·75	2·30
Tophouse	3·44	9	1·39	4·50
Hanmer Springs	1·48	7	0·72	2·93
Highfield, Waiau .. ..	..	..	..	2·59
Gore Bay	1·09	5	0·62	3·50
Christchurch	0·45	6	0·26	1·84
Timaru	0·68	6	0·28	1·89
Lambrook Station, Fairlie	0·74	6	0·46	1·95
Benmore Station, Omarama	0·84	5	0·32	1·23
Oamaru .. ..	..	..	..	1·72
Queenstown	1·33	3	1·02	1·76
Clyde	0·96	7	0·33	0·99
Dunedin	1·37	8	0·65	2·69
Gore	2·70	11	0·83	2·47
Invercargill	2·46	12	1·02	2·68

HONEY—GRADING DATES, 1924.

THE following dates have been fixed by the Department for the grading of export honey at the respective centres—

	March.	April.	May.	June.
Auckland .. ..	.. 20	1	1	2
Wanganui	9	9	9
Wellington	12	13	13
Lyttelton	17	17	17
Timaru	21	21	21
Dunedin	25	24	24
Bluff	26	26	..
Greymouth	28	..	26

Producers are requested not to forward their honey to grading-store more than fourteen days prior to the date fixed in each case.

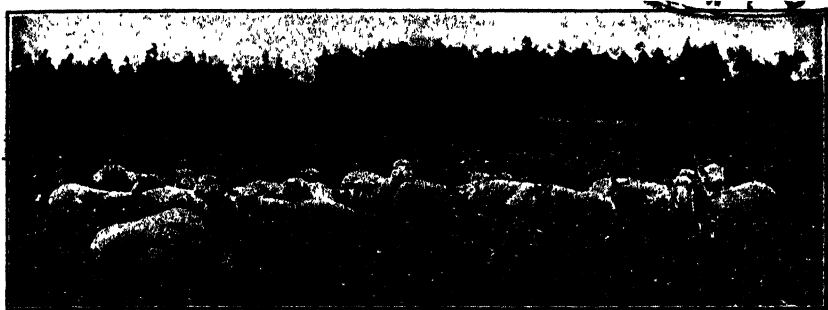
SHIPPING-FACILITIES BETWEEN VANCOUVER AND BRITAIN.

THE New Zealand Government Agent at Vancouver in a recent communication draws attention to the regular service of refrigerated freight steamers maintained by the Royal Mail Steam Packet Line between Vancouver and Great Britain via the Panama Canal, the passage occupying about forty-two days. The company is pushing the trade, and large quantities of apples from Canada and the United States have been shipped to British ports by this route. Trial shipments of butter to Britain have also been successfully made from Alberta, which province is rapidly expanding its dairy industry, and may at certain times have a surplus for export. The rate of freight on butter from Vancouver is \$1.50 per 100 lb.

MEAT-FREEZING WORKS IN NEW ZEALAND, 1923-24.

Name and Address of Company. <i>Land District.</i>	Name and/or Location of Works.	Beef-killing Capacity per Day.	Sheep- killing Capacity per Day.	Storage Capacity in 60 lb. Carcases Mutton
<i>North Auckland and Auckland.</i>				
Auckland Farmers' Freezing Company, Ltd., Auckland	Moerewa ..	200	2,000	100,000
" " " "	Southdown ..	200	3,000	126,000
" " " "	Horotiu ..	200	3,000	66,000
Westfield Freezing Company, Ltd., Auckland ..	Westfield ..	200	3,000	205,000
R. and W. Hellaby, Ltd., Auckland ..	Westfield ..	120	500	3,000
East Coast Co-op. Freezing Company, Ltd., Whakatane	Whakatane ..	200	1,000	120,000
<i>Hawke's Bay and Gisborne.</i>				
North British and Hawke's Bay Freezing Company, Ltd., Napier	Westshore* ..	50	2,500	40,000
Thomas Borthwick and Sons (Aus.), Ltd, Christchurch ..	Pakipaki ..	30	1,500	64,000
Nelsons (N.Z.), Ltd., Tmoana ..	Tomoana ..	80	4,000	175,000
Hawke's Bay Farmers' Meat Company, Ltd., Hastings ..	Whakatu ..	80	4,000	75,000
Wairoa Farmers' Co-operative Meat Co., Ltd., Wairoa ..	Wairoa ..	100	3,000	165,000
Nelsons (N.Z.), Ltd., Gisborne ..	Waipaoa ..	150	4,000	270,000
Gisborne Sheep-farmers' Frozen Meat and Mercantile Company, Ltd., Gisborne	Kaiti ..	150	4,000	422,000
Ditto ..	Tokomaru Bay ..	60	3,000	140,000
" " " " " " " "	Hicks Bay ..	75	1,500	60,000
<i>Taranaki.</i>				
Taranaki Farmers' Meat Company, Ltd., New Plymouth	Smart Road* ..	125	2,000	160,000
Thomas Borthwick and Sons (Aus.), Ltd., Waitara ..	Waitara ..	200	2,000	82,000
New Zealand Bacon and Meat Packing Company, Ltd., Wellington	Eltham* ..	60	..	25,000
Patea Farmers' Co-op. Freezing Company, Ltd., Patea	Patea ..	120	2,000	180,000
<i>Wellington.</i>				
Wanganui Meat-freezing Company, Ltd., Wanganui ..	Castlecliff ..	100	2,200	100,000
New Zealand Refrigerating Company, Ltd., Christchurch	Imlay ..	200	6,000	271,000
Otaihape Farmers' Meat and Produce Co., Ltd., Taihape	Winiata ..	50	1,200	90,000
Felding Farmers' Freezing Company, Ltd., Felding ..	Aorangi ..	100	4,000	153,500
National Mortgage and Agency Company of New Zealand, Ltd. (Head Office, Dunedin)	Longburn ..	60	1,500	165,000
Wairarapa Frozen Meat Company, Ltd., Masterton ..	Waingawa ..	250	6,000	270,000
Gear Meat Preserving and Freezing Company of New Zealand, Ltd., Wellington	Petone ..	100	10,000	300,000
New Zealand Bacon and Meat Packing Company, Ltd., Wellington	Ngahauranga ..	120	3,000	120,000
Wellington Meat Export Company, Ltd., Wellington ..	Ngahauranga ..	120	8,000	240,000
" " " " " " " "	Kakariki* ..	100	2,000	90,000
<i>Marlborough and Nelson.</i>				
New Zealand Refrigerating Company, Ltd., Christchurch	Picton ..	30	2,000	30,000
Nelson Freezing Company, Ltd., Nelson ..	Stoke ..	30	500	50,000
<i>Canterbury.</i>				
Canterbury Frozen Meat and Dairy Produce Export Company, Ltd., Christchurch	Belfast ..	120	7,000	252,000
Ditto ..	Fairfield ..	..	4,000	100,000
" " " " " " " "	Pareora ..	25	4,500	233,000
New Zealand Refrigerating Company, Ltd., Christchurch	Islington ..	50	7,000	375,000
North Canterbury Sheep-farmers' Co-operative Freezing Company, Ltd., Christchurch	Smithfield ..	50	6,000	304,000
Thomas Borthwick and Sons (Aus.), Ltd., Christchurch ..	Kaiapoi ..	70	4,000	222,000
" " " " " " " "	Belfast ..	..	5,000	105,000
<i>Otago.</i>				
Waitaki Farmers' Freezing Company, Ltd., Oamaru ..	Pukeuri ..	..	3,500	230,000
New Zealand Refrigerating Company, Ltd., Christchurch	Burnside ..	50	3,500	216,000
South Otago Freezing Company, Ltd., Balclutha ..	Finegand ..	50	2,500	175,000
<i>Southland</i>				
Ocean Beach Freezing-works (J. G. Ward and Co., Ltd., Managing Agents), Invercargill	Ocean Beach ..	100	2,500	110,000
Southland Frozen Meat and Produce Export Company, Ltd., Invercargill	Mataura ..	50	2,000	104,000
Ditto ..	Makarewa ..	120	2,000	75,000
" " " " " " " "	Bluff	114,000
Totals	4,345	145,900	6,962,500

* Not operating season 1923-24.



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BUSH-SICKNESS INVESTIGATION.

FIVE YEARS' WORK AT THE MAMAKU DEMONSTRATION
FARM.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

INTRODUCTION

THE Mamaku Farm was purchased by the Department of Agriculture in 1912 for the purpose of studying the obscure malnutrition or deficiency disease in domestic ruminants which occurs in an extensive area of pumice land in the Lake district of the North Island, and to some extent on the lands which lie between that district and the coast. This trouble, which manifests itself as progressive anaemia, is variously known to the settlers as "bush sickness," "bush disease," or "the skinnies." The latter is the most graphic name, as it precisely conveys the ultimate condition at which animals arrive after a few months' sojourn on the luscious-looking pasture, chiefly red and white clovers and cocksfoot, of the region under review. Previously the Department owned no farm in the bush-sick area on which experiments could be carried out, but had relied on certain leased areas at Lichfield, Mamaku, and Te Pu on which temporary experiments in grazing were conducted (See *Journal* for November, 1912, April, 1913, and June, 1913). Mamaku, it may be mentioned, is situated fourteen miles north-west of Rotorua, on the railway-line.

For the present Mamaku Farm, at first 305 acres were acquired of land which had been tawa-rimu forest, but a considerable portion of which had been felled, burnt, and surface-sown by the original owner, Mr. R. A. Jackson. A further 212 acres were purchased in 1920, making a total of 517 acres. Mr. Jackson had purchased the "bush" or forest some twenty-eight years before, and had felled about 200 acres and grassed it for a first clearing. Every year subsequently, for some years, he had felled, burnt, and grassed some 80 acres, surface-sowing it with a seeding of 30 lb. of cow-grass and cocksfoot mixture per acre. Good logs were sold to the local sawmill, and the owner also carried on a butchery business, from which his main income was derived. As showing the effects of the disease, it may be here stated that no farmer in this district who relied upon his farm alone for a living and who had no other business but farming had been able to carry on. Those who survived had had some business to financially assist their farming activities, or some farm outside the bush-sick area on which to change their stock.

At the time of taking the farm over there was only one small paddock adjacent to the homestead which had been logged up and ploughed. Since then and up till 1919 some 20 additional acres had been logged up, ploughed, and cropped. Experiments had been laid down to ascertain the effect of top-dressing the surface-sown pastures with various artificial manures and soil amendments such as lime, and subdivision of the paddocks into smaller areas had been carried out, some 168 acres being thus divided into eleven paddocks of various sizes. Experiments had been conducted in the medicinal treatment of cattle with drenches, licks, and medicated drinking-water, and in pasturing stock on paddocks variously top-dressed compared with those which received no dressing. The experiments were carried out with both sheep and cattle. A supply of water had been assured by the construction of tanks peculiar to this country, made by hollowing out elevated necks of soft volcanic rhyolitic breccia rock, giving the pit thus dug a coating of Portland cement, and erecting round its sides an iron roof—a reservoir which effectively collected and retained the water in this region of copious rainfall. The sites of these tanks were so well situated above the general level of the farm that the water could be piped off to every paddock. The tanks hold, when full, some 16,000 gallons. Root crops had been grown and meadow and oaten hay stored for winter feed. Up to this time (1919) it had been amply demonstrated by experiments at leased sites and at the Mamaku Farm that top-dressing the old surface-sown pasture led to a very great improvement in its feeding-quality, and, when phosphate was the dressing, of its quantity also. The writer may here be pardoned for a brief digression which may help to throw some light on a difficult aspect of the problem.

It seems obvious that both grasses and clovers can and do flourish on this bush-sick country; they go through their life-cycles perfectly, growing to a good size and producing fertile seed. Top-dressing with phosphate enormously increases the yield of clovers and leguminous plants, and a general improvement of pasture-condition may be noticed after such treatment. The only manurial ingredient the pasture-plants profit by, so far as they are concerned, is phosphates.

That this is not sufficient for the animal grazed is evidenced by the fact that it cannot remain healthy on such improved pasture for longer than a year or two years. What is sufficient to the plant is evidently insufficient for the animal. If the pasture be top-dressed with an iron salt the result is to decrease the clovers and hence reduce the carrying-capacity. The net result, however, is that stock can be carried longer on this pasture than on any other, because they can remain healthy on iron-dressed pasture longer in spite of the decreased quantity of herbage. The pasture of bush-sick country evidently either takes up from the soil too much or too little of some substance, or else elaborates some poison, for it is clear that such green pasture does not, as it should, supply the requirements of the animal.

It is to arrive at the practical method of combating this discrepancy that the necessity arises for a demonstration farm conducted along lines which the man with average capital, experience, and ability can follow. With a view to diminish the cost of running such a farm it has been decided to try and make as much profit as possible by farming in the old-fashioned way with such country--namely, to buy stores, improve them in the limited time they can be carried before showing signs of sickness, and sell them at a profit; further, to try side lines such as horses, pigs, poultry, bees,* &c., with the idea of increasing the chances of survival of the settler, who would certainly succumb were ruminants in this country the sole class of stock and the method of farming the ordinary one. Thus the operations of this demonstration farm may be divided into experimental and profit-making, and until a new treatment is proved an economic success it is not proposed to try it on more than a few animals at a time, thus restricting any loss as much as possible.

It may therefore be taken as effectually proved that up to the year 1919 the only improvement in the general farming of the district that had been demonstrated as feasible was the efficacy of phosphate dressings, firstly, in increasing the carrying-capacity, and, secondly, in enabling stock to be kept healthy for a longer period than if phosphates were not applied. On the profit-making part of the farm the stock are therefore part-time grazed on paddocks which have been liberally treated with a phosphate dressing. Such a progressive innovation has, however, not been generally adopted by the farmers in the immediate vicinity. They are evidently awaiting the ultimate results of the demonstration farm before taking any steps which may prove only an alleviation but not a cure. Numbers of landowners on the Mamaku Plateau are at present holding on to their properties, paying rates, &c., but not improving them. They are apparently merely marking time until a definite official pronouncement of how to farm these lands is issued, as the result of the Mamaku Demonstration Farm operations. A cessation of the demonstration farm's activities, in the absence of such a pronouncement, would be construed into a confession that Mamaku land could not profitably be farmed, and lead to an abandonment of holdings and fall in land-values.

So far in this article only mature stock have been referred to; another aspect of bush sickness is that young stock cannot be raised

* So far provision has been made for pigs only.

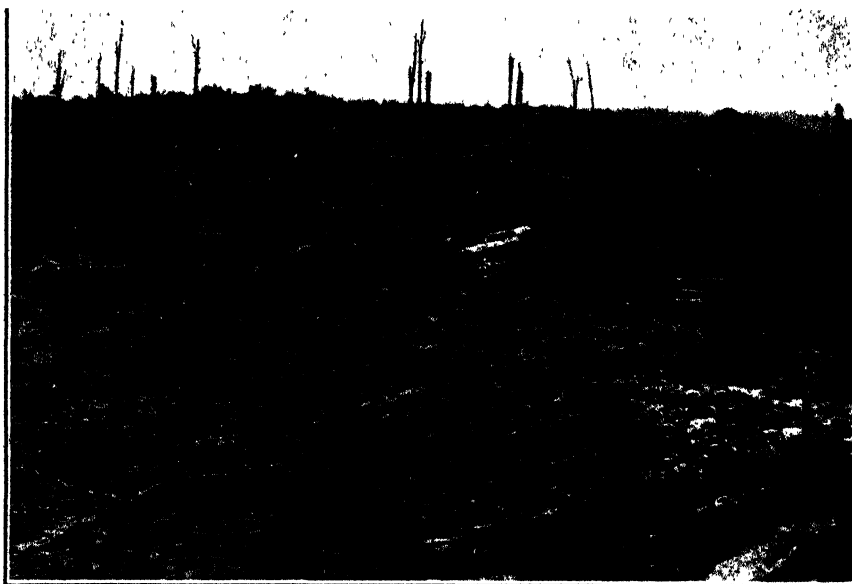
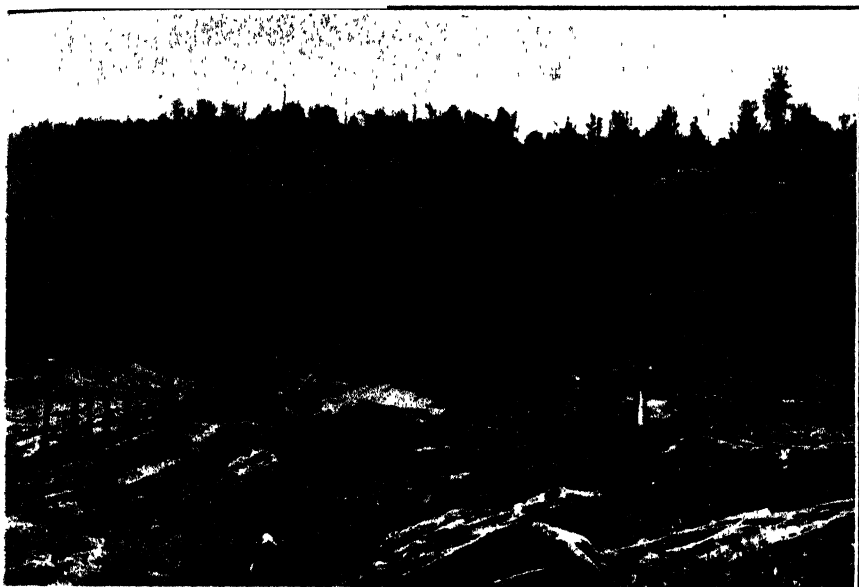


FIG. 1. GENERAL VIEW OF THE

The stages in the conversion of this class of country into arable land are a scenic reserve which separates the farm from the Rotorua Railway line. In which results from the surface-sowing of a bush-burn. This stage ordinarily under the plough for the first time, the stumps having been blown out with high only completed in November last, when the photo was taken. A fine crop of which has been down some years after cropping with roots.

beyond the weaned stage. This is a general statement ; the truth probably is that in the worst areas neither lambs nor calves can be reared, while in other districts only calves can be raised but never lambs. At Mamaku Farm, which was typical of the most bush-sick class of land, considerable progress had been made up to the year 1919 in delaying the mortality in weaned calves by the aid of organic iron salts and artificial feeding—the period at which they could be kept alive on grass had been lengthened. Indeed, two heifers (" Mary " and " Jane ") had been successfully raised to maturity, had given birth to several calves, and had been milked ; but their progeny had in all cases died ultimately, although one survived nine and another twelve months. These heifers were, however, the outstanding exceptions. Born on the farm in 1914, after their first calves were born the dams were kept alive by unremitting attention involving constant supply of iron (as inorganic salt-lick), almost continuous drenching with iron phosphate, pasturing on a paddock recently top-dressed with superphosphate, and, lastly, administration of Ferri. Ammon. Cit. (commercial), which had the most effect of all the treatments. Finally they were sent to Tirau for a good spell of six months in 1922, brought back to Mamaku (where they put on condition very fast for the first time without medicine), and sold as beef in January, 1923. In the majority of cases, no matter



MAMAKU DEMONSTRATION FARM.

shown in the photograph. On the extreme right is a belt of tawa-rimu forest, the foreground and background is the pasture growing among stumps and logs lasts from ten to twenty years. In the left middle foreground is seen the land explosive and drawn together and burnt. The ploughing of this paddock was turnips is now growing as a first crop. In the right middle foreground is pasture

[All photos by B. C. Aston.]

how healthy the calves seemed up to eight or nine months, they could not be reared to the yearling stage, the exceptions being only occasional.

Turning now to the experience with sheep, it may be premised that this ruminant is by far the more susceptible to bush sickness, and can be carried on bush-sick pasture for relatively a much shorter period than cattle. The Mamaku country, with its heavy rainfall, high elevation, and rush of rank pasture in the early summer, is not what one would recognize as typical sheep-country; and, descending to the particular, this farm is by no means well situated for sheep-farming. It is rather too close to a large settled area, the paying industry of which is saw-milling. The attentions of dogs have proved a constant source of anxiety, and losses out of every lot of sheep carried have been sustained from this cause. On one occasion eighteen were killed in one night. For sheep, the boundary-fences of a large area have necessarily to be kept in better order than for cattle; hence, on this and on other accounts, the experiments at Mamaku have mainly been confined to cattle. The outstanding fact, however, had been demonstrated, that sheep may be kept for two years on pasture top-dressed with iron-salts. Every sheep-farmer will realize the difficulty in keeping the same sheep in the same paddock for two years for experimental purposes, and the

difficulties were very much greater when, as in this case, the paddock was in a rough stumpy condition and in a back part of the farm difficult to supervise. In the second year it was seen that the iron compounds had had a marvellous effect in keeping this more susceptible ruminant healthy, a result which was merely a confirmation of the Lichfield and Martin's paddock (Mamaku) experience with sheep on pasture dressed with iron salt.

THE PAST FIVE YEARS' WORK.

We now arrive at the date at which this article takes up the history of the experiments. The Department is now in possession of a rough bush-farm, with a working manager and an assistant resident on the premises, about one mile from a prosperous sawmilling township and railway-station. To the eye the country is very suitable for cattle; although at 1,800 ft. elevation, grasses and clovers grow well most of the year. The surface is flat with the exception of the volcanic mounds or necks which in many places project through steep grassed slopes, forming rocky outcrops of great value to the district for roadmaking and for the construction of the elevated tanks already mentioned. Creeks are few and far between on the Mamaku Plateau. Where shallow watercourses do occur they soon disappear into one of the crevasses which seam the country. Hence provision for watering cattle must be artificially contrived. This rhyolitic rock underlies the surface soil, which is composed of coarse pumice, air-borne from the distant mountains or, more probably, from the enormous extinct crater on which now stands the town of Rotorua. After stumping the land is eminently suitable for cultivation and for the growth of winter feed, the swede crop being exceptionally good and free from disease. The rapid and continuous growth of pasture in all but the three months of winter, the abundant and well-distributed rainfall, the porous soil, the absence of all swamps, and the possibility when the country is brought under the plough of growing ample winter feed (root crops and hay), the proximity of good roads, a railway-station within a mile, and two dairy factories eight miles distant by rail—are all factors indicating the possibility of dairying as the most profitable utilization of the country after the sawmill has taken its toll of timber from the land. Operations during the last five years have been largely directed towards proving the possibility of dairying on this type of country, which, if successful, may reasonably be expected to substantially increase the present value of the land.

PERMANENT IMPROVEMENTS.

Since 1919 some 35 acres have been stumped, ploughed, and sown in turnips and other crops, and subsequently laid down in grass. The main access to the farm, a private road from the main Mamaku Road, has been logged up and planted on each side with trees. On paddock No. 9, near the homestead, a site has been excavated, and permanent farm-buildings, consisting of office, man's room, combined implement, wool, and trap shed, and pigsties have been erected. This building replaced a dilapidated barn and slaughterhouse, the good timbers of which were utilized in the new building. The whole of this work was accomplished by the Farm Manager (Mr. Jackson) and his assistant.

with the aid of a local carpenter. A fence was erected round the farm-buildings, and concrete bails, yard, and shelter for the calves constructed. On wet days during 1921 gates for the farm were constructed. The homestead has been thoroughly renovated and made comfortable. Portions of shelter-bush trees near the homestead have been ring-fenced. Fences on the home paddocks have been repaired with posts split on the farm. The stockyards have been put in thorough repair with totara posts cut on the farm. A large paddock near the homestead has been made pig-proof, and it is proposed to use it for experimental pig-farming. Crevasses on the farm, peculiar to this plateau, have been ring-fenced and planted to prevent stock falling in.

CROPPING, ETC.

Every year since 1919 some 16 acres have been devoted to root crops, Crimson King and Superlative swedes being favourites. The manuring for these has been from 3 cwt. to 4 cwt. of phosphates per acre, basic super being the chief ingredient. It is significant that on a portion of land which had previously been limed by top-dressing, a Chewings fescue paddock (No. 5), two good crops of turnips were obtained in consecutive years, superior to those on land which had not been limed. In this paddock, contrary to the general experience, the land was found to be full of earthworms. Liming evidently has a good influence on the turnip crop, although its effect on bush-sick pasture is not apparent for some years, and animals pastured on newly limed areas become bush-sick quicker than on the untreated pasture.

Large quantities of meadow hay have been saved each year. The quantity is usually about 20 tons, but this year there is about 30 tons available for the winter. In addition, oaten hay (10 tons in 1923) and oats and vetches have been saved. There are now about 65 acres of well fenced, stumped, and cultivated paddocks available for cropping, 120 acres of surface-sown pasture in rough stumpy condition which has been improved by phosphatic top-dressing, and 262 acres in rough surface-sown pasture which has not been improved by top-dressing. The remainder of the farm area, 70 acres, is in standing bush (tawa forest).

PROFIT-MAKING.

As is well known, during the last few years the beef-market has become unprofitable, while dairying has prospered. It is, however, inadvisable to launch out into dairying on the Mamaku Farm until it is proved conclusively that this branch of cattle-farming can be successfully carried out on a large scale there without periodically resorting to changing the cows on to healthy country. It will take a few years to prove whether this can be done, and seasonal and other uncontrollable factors must be guarded against by not placing too great a reliance on one or two years' favourable results. It has therefore been decided that only a maximum of about a dozen cows shall be used as the experimental dairy herd. Seeing that this is essentially cattle-country rather than sheep-country, the only two avenues of revenue from cattle are somewhat narrowed, and one must not be despondent if on the profit-making section of the farm no great profit can be shown. The farming operations for the period under review

have been therefore almost entirely restricted to the grazing and fattening of store cattle. Stocking has, of course, been necessary to prevent deterioration of the pastures where so much is in the rough stump condition, and where the land is liable to be invaded by noxious weeds, particularly blackberry and ragwort, from adjacent infested areas.

In 1919 129 store sheep were bought at 16s. and sold fat three months later for 30s. Twenty cows after being nine weeks on 8 acres of turnips all did well, one half being fat; thirteen bought in June for £7 sold at £11 in September. Eighty-one steers bought for £7 to £11 each sold for £9 to £10. Eight cattle were sold off turnips at satisfactory prices. In 1920 a mob of 141 ewes was purchased at Morrinsville in June; only eighty proved to be in lamb; they did well up to about two months after docking, and that was the time when normally they should have been sold. It was decided, owing to the statements that the sickness was disappearing as the country grew older and that top-dressing should make a considerable difference in the time that sheep might be kept, to hold the ewes for a longer time, in order to test these theories. They could not be sold until 15th December. By this time, owing to bush sickness and to the attacks of dogs, the sheep had gone back considerably, twenty-two being lost. The mob originally cost £161, and the sheep were sold for £173. Both the wet ewes and the lambs went back most, but fifty-three of the stronger-constituted ewes held their own and fetched 25s. 6d. Eighteen made 23s., and seventy-seven (with lambs in) 22s. This was a useful experience, and therefore worth recording, although an unprofitable operation. No doubt more sheep-grazing would improve the pastures as well as provide a good profit. A considerable outlay on fencing for subdivision and improvement would, however, be necessary.

In 1921 sixteen fat bullocks were sold at the Hamilton sale, topping the market at £9; eight made £8 4s. net, eight £7 net, and three more were disposed of locally. On 21st May forty two-year-old steers (bought 6th October, 1920) were sold at £7 2s. 6d. In December two hundred grazers (yearling heifers) were taken in at 6d. per head per week and yielded a net profit of £80. In June eleven fat cows were sold, six at £3 2s. and five at £1 10s.

In 1922, in August, twenty heifers sold at Matamata sale for £5 each, a profit of about £1 per head. In September one heifer sold at Tirau for £6 5s. In October twenty-six head of stock were disposed of, prices for some of the springing culled cows being fairly good. The heifers fetched only poor prices. Six pigs sold for £2 10s. per head at Putaruru.

In 1923 sixteen bullocks, which cost £3 13s. per head, were sold in April at the Claudelands sale for £4 18s. Fifty good-conditioned two-year old heifers purchased in February, 1922, made a gross profit of £30, which was not sufficient for handling them; twelve proved to be empty. They were on the farm only five months, and had turnips and hay; notwithstanding this they lost condition after being on the farm six weeks, and were in low condition when sold. Thirty-one store cattle wintered well and brought a profit of £1 10s. each. In May another truck of fat cattle were sold to the butcher for £4 17s. 6d.

each. In June sixty-four cattle were sold at Morrinsville sale at £4 1s. One hundred and five three-year-old steers, costing £3 13s. 3d. each in the spring of 1923, were disposed of by selling forty at £4 1s.; others were sold later, but the price was a poor one considering the good condition the animals were in. Thus bad markets in this case nullified what should have been a successful grazing operation. After November, 1923, fifty-six store steers were disposed of.

In 1924 twenty-four cattle were sold at £7, and eight at £5; twenty-three others were also sold, a total of forty-seven disposed of.

These extracts from the farm reports do not represent a prosperous condition of things, but the handling of these stock provided valuable experience, and, in addition to the small profit, supplied the means of "carrying on" and improving the pasture and gaining additional experience in working the country.



FIG. 2. SOME COWS OF THE EXPERIMENTAL HERD AT THE MAMAKU FARM.

From left — "Brindle," "Polly," "Darkey," "Daisy," "Cherry." Photo taken in February last.

So as not to be entirely dependent on ruminants, it is proposed in the coming year to determine what can be done in pig-farming, although even this must be limited in scope until demonstrated beyond doubt not only that it will pay (of which there is very little doubt) but that the food produced under the conditions of this peculiar type of country is such that the grazing of pigs can be successfully carried out on a large scale. There appears to be considerable hope for this new industry in the district. Not only is pig-raising to a certain extent complementary to the dairy industry through securing a profitable use for skim-milk, but the soil is more particularly adapted to the growing of several important fodder crops suitable for pig-feed than is the soil of non-pumice districts. If pigs are not affected in any way by the factors which cause bush sickness—and there is

prepared in the laboratory by merely warming lemon or limejuice with freshly prepared ferric hydrate until it dissolves, and subsequently adding enough ammonium to form the double salt in solution, this home-made solution is far quicker in its action than the bought "crystals" (which latter are merely scales). It will be observed that the bulky solution has not been concentrated or even boiled. The vitamine enthusiasts will probably offer the explanation that the lemon-juice supplies vitamins, whereas the commercial Ferri. Ammon. Cit. does not; but in answer to this, if lack of vitamins is to be in any way held responsible for bush sickness the present conception of vitamins must be greatly enlarged. At present one cannot learn of any instance in which ruminants fed on mixed green pasture have been proved to suffer from lack of vitamins.

Another factor which has proved highly instrumental in keeping stock free from bush sickness is the winter feeding with turnips, another food which the said enthusiasts will quote as having a high vitamine content. The turnip is a great storer of phosphates, and the ash of turnips is differently balanced from that of grasses and comparatively rich in iron.

MEDICINAL AND OTHER TREATMENT OF DISEASED COWS.

Following are detailed notes of the treatment and effects on experimental milch-cows for four years. All of these cows came from the Morrinsville district.*

"*Nigger*," seven-year-old Friesian cow. Arrived at farm 27/10/20; calved 29/4/21. Was given $\frac{1}{2}$ lb. linseed in locally grown chaff twice daily from 27th May, also hay and turnips. At 31st July was looking and milking well, giving 4 gallons per day. At 30th August was going off in milk, giving only 3 gallons; at 30th September the milk had decreased to $2\frac{1}{2}$ gallons, at 18th October was giving 2 gallons; at 1st November was going bush sick, only 11 lb. per day; so on 14th November, having fallen away considerably, the cow was taken to the change paddock at Tirau (on healthy country). The cow was brought back from Tirau on 3/3/22 quite recovered and had put on great condition. On 19th June she was found lying dead in a position which suggested heart-failure—no apparent cause.

"*Darkie*," Friesian, dehorned eight-year-old cow. Arrived 6/7/21; calved 29th July. On 5th September commenced to feed $\frac{1}{2}$ lb. linseed and 3 lb. local chaff twice daily. At 1st October was improving in condition, giving 26 lb. milk daily; at 1st November milk increased to 30 lb. daily, and cow looking well. Artificial feeding had to be discontinued on 15th November, as there was too much grass and she would not take the linseed. At 30/1/22 cow was looking well, giving 20 lb. milk; at 28th February was still in good condition, and giving 15 lb. milk. At 30th March feeding with linseed was recommenced, cow now giving 11 lb. milk. On 30th April the milk was reduced to 8 lb. On 1st May the cow was rugged and hay was fed to her in paddock. When still well, on 12th June, she was dried off and commenced to run on turnips two hours each day. She was looking well till 31st July, having been receiving linseed 30/3/22 to 31/7/22. At 31st August, cow, being in good condition, was springing, and calved on 25th

* The locality whence imported stock are derived exercises a great influence on their subsequent health at Mamaku, and the relative resistance which they offer to the disease. Mr. Gamman, of Tauranga, has given the Department some valuable information with regard to his experience in using cattle obtained at as great a distance as possible from the bush-sick area. Animals purchased by him in large numbers from the Marton district have proved to be remarkably immune when transferred to bush-sick country. This aspect will be further investigated at Mamaku.

September; calf apparently had been dead for some time. Cow still getting hay and turnips, but giving very little milk. At 31st October cow was at a standstill, giving only 15 lb. milk daily. In November cow refused to take artificial food readily, perhaps on account of abundance of fresh feed. Every sign of bush sickness present. At 30th November stopped treatment owing to abundance of fresh feed. The cow was at a standstill or going back slightly, giving 10 lb. milk daily. On 6th December commenced to drench with potassium iodide solution, 1 fl. oz. with a teaspoonful of salt added, once a day; on 22nd December finished drenching with iodide, which effected no change. At 1/1/23 no improvement noticeable.

On 15th January commenced to drench with citrate of ammonium and iron made from Cook Island limes, 3 fl. oz. twice a day. Stopped drenching on 8th March, cow showing signs of improvement, and being milked once a day. Recommenced drenching with 3 fl. oz. of commercial Ferri. Ammon. Cit. The improvement continued to 20th May, when the drenching was stopped, the cow having much improved.

On 20th May commenced feeding with local chaff and 1 lb. molasses twice a day, and gave turnips and hay from 1st July in addition to chaff and molasses mixture. The improvement was maintained, and at 1st September she was springing to calf. On 15th September the molasses was reduced to once a day, but the full daily dose of 2 lb. was maintained in locally grown chaff. The turnips were now finished, but the molasses treatment was continued up till the date she calved--16th September--quite naturally, the calf being strong and healthy and the cow in first-rate condition. This cow therefore has had every kind of treatment, and the net result is that at the time of writing (March, 1924) both the cow and calf (a brindle bull calf) are still in excellent condition.

"*Te Kuili*," a grade Jersey cow, four years old. Arrived at farm 22/3/22, calved 6th October, when in first-rate condition. Commenced feeding on 2 fl. oz. of iron and ammonium citrate made from Cook Island limes, with 3 lb. of locally grown chaff, twice daily. At 31st October she was giving 3 gallons of milk, and the citrate medicine was stopped, as she refused to take the dry chaff when there was such an abundance of green feed. She continued in excellent condition, and was giving 22 lb. milk on 1/1/23, and 20 lb. at 1st February. At 1st March she was noticed to be dull about the eyes but still in good condition; weight of milk, 15 lb. At 1st April she was losing condition, thought to be first signs of bush sickness. At 1st May she was going back quickly and giving only 7 lb. milk, being milked once daily. On 20th May commenced feeding 2½ fl. oz. of the commercial iron and ammonium citrate in local chaff twice daily. At 1st June, in addition to medicine, she was getting hay and turnips. At 1st July a slight improvement was noticed; the cow was rugged, as the weather was extremely severe. At 1st August she was looking much better, and was getting much turnips and hay. At 19th August she slipped her calf and was too far off to come to milk. At 1st September she was slowly improving, still getting medicine in chaff, and turnips and hay fed out to her. It had been stopped to enable another treatment to be tried, but as the medicine for this did not come to hand she was put back on to the Ferri. Ammon. Cit. By 15th September she improved, and went to the bull 20th. On 15th October she was improving quickly and the medicine was stopped. She is now in good condition.

"*Cherry*," Ayrshire-Hereford crossbred cow, six years old. Arrived at farm 5/9/20; calved 1st November. Milking well, giving 5 gallons a day. Commenced giving 2½ fl. oz. Ferri. Ammon. Cit. twice daily in 3 lb. of local chaff. At 17/9/21 was milking once a day, giving about a gallon and looking well, showing no signs of sickness. On 14th November, as this cow had gone bush-sick and no improvement could be effected, she was taken to the Tirau paddock, and brought back on 4/3/22. She slipped her calf when away. She was in good condition on 1st May and went to the bull. On 30th November she was again going bush-sick fast, giving only ½ gallon of milk. On 6th December commenced to drench with 3 fl. oz. of iron and ammonium citrate, home-made from Cook Island limes. On 25th December drenching was stopped, as she had improved in condition and was giving 1½ gallons. On 15/1/23 the treatment was recommenced, giving 3 oz. twice daily, which was stopped on 13th February, as the cow had further improved and was giving 2 gallons. Recommenced to drench with 3 fl. oz. of iron and ammonium citrate on 15th March, and she steadily improved in condition and continued to give 2 gallons till 4th May, when the medicine was stopped, the condition of the cow being fully restored, with a daily yield of 1 gallon of milk.

On 20th May a treatment of molasses was commenced, given in local chaff twice daily. This cow was now in a fair condition. At 1st June she was getting hay and turnips. At 1st August the molasses treatment was still being given, with hay and turnips in plenty. Her condition was now stationary or, if anything, going back. She was still giving 6 lb. of milk a day. This treatment was continued until 15th September, when all the turnips were finished, and the molasses and chaff treatment was reduced to once a day, a slight improvement being noticed. On 17th October she calved, the calf being strong and healthy but a little thin. On 22nd October she was giving 37 lb. milk, and on 31st 45 lb. At this time she was getting 3 lb. of molasses per day, and this was continued until 10th November, when the molasses treatment was discontinued, the cow milking well and slowly putting on condition. At 26/3/24 condition good; milking well; again in calf.

"*Brindle*," a dehorned seven-year-old Jersey-Shorthorn. Arrived at the farm 6/7/21; calved 8th August. At 5th September molasses treatment with local chaff was commenced twice daily. At 1st November she was giving 15 lb. of milk and improving in condition. At 1st November giving 40 lb. milk; at 15th the molasses was stopped owing to there being too much grass. At 13/1/22 she was giving 35 lb. and at 28th February 22 lb. At 30th March she was yielding 15 lb., and the molasses treatment was recommenced. At 30th April giving 10 lb. of milk. On 1st May she was rugged, and feeding on meadow hay commenced. At 12th June, when still looking well, she was run on turnips two hours each day. On 1st September, having had the molasses regularly since 30th March, she calved, the calf, a white-faced Hereford bull, being strong, and the cow in excellent condition. At 27th September the cow was giving 45 lb. of milk daily. At 31st September, 50 lb. milk, with the cow still in excellent condition. She went to the bull on 18th November. At 30th November, the cow being in excellent condition and giving 45 lb. of milk, supplementary feeding was stopped, there being abundance of pasture and the animal not taking dry food readily. At 30th December she was giving 40 lb. milk, at 30/1/23, 35 lb.; 1st March, 20 lb.; 1st April, 15 lb. daily. At 18th April feeding with molasses in local chaff once a day was recommenced. All this time the cow had been in excellent condition, and she was dry on 25th May. On 1st June hay and turnips were given, and continued with molasses treatment till 15th September, when instead of getting the ration of 1 lb. twice a day she got it once a day in local chaff, and the turnips were discontinued. On 15th October, her condition having been first-rate all along, molasses feeding was stopped. She calved on 4th November, the calf, a bull with a little brindle on back, being strong and healthy. At 10th November she was giving 50 lb. milk. At 10/3/24 weight of milk 31 lb. daily; condition good; again in calf. This cow is therefore in the unique position of having raised two healthy calves on the Mamaku Farm without a change to healthy country.

"*Roanie*," six-year-old light roan Shorthorn. Arrived 6/7/21; calved 20th August. Commenced feeding 2 lb. bran in 3 lb. local chaff, twice a day. At 1st October found to be not improving like other cows, giving 24 lb. of milk. At 1st November was improving and giving 28 lb. of milk. At 15th November had to stop feeding bran owing to abundance of green feed. At 30/1/22 looking well and giving 15 lb. of milk. At 30th March commenced to feed bran again; giving 12 lb. of milk; at 30th April, 9 lb. At 1st May started on meadow hay, and rugged with sack up to 8th June; was looking well, and aborted at seven months. At 12th June commenced to run on turnips two hours daily; was losing condition at 31st July, but was being milked once daily only right through the winter. The bran treatment had been continued since 30th March. At 31st August the cow was losing condition, taking food erratically, and continued to go back till 31st October, when she was moved to the Tirau paddock for a change. On 17/3/23 she was brought back in fair condition, which she maintained till 20th May, when she was given 2 lb. molasses in local chaff daily. She was in good condition at 1st June, when hay and turnips were supplied. On 4th August she slipped her calf, and was too far off to come to milk. On 15th September, the good condition having been maintained all through, the molasses was reduced 2 lb., being given only once a day in local chaff. This was discontinued on 15th October, the cow being then in very good condition.

Four cows had no special treatment at first, but were given turnips and hay in winter.

"*Maud*," a Shorthorn crossbred red-and-white four-year-old cow. Arrived at farm 6/6/21; calved 26th August, and gave some trouble in calving, calf being

born dead. Gave only 3 pints of milk at 6th September; improved and gave more milk up to 15th October, when the flow decreased and was reduced by 30/4/22 to 6 lb. At May she was rugged, and was dry by the 30th. She was put on turnips for two hours daily and continued looking well and in good condition until 30th September, when first signs of bush sickness were manifested in dry coat. About 18th October calf again born dead, and cow went back in condition and gave very little milk. Went to Tirau paddock on 2nd November for change, as coat was rough, flanks hollow, and eye dull. She was brought back from Tirau on 1/4/23, looking well, and improved considerably within a month of coming back to the old pasture.

At 20th May commenced feeding 1 lb. molasses in local chaff twice daily. This was continued with plenty of turnips. On 15th September, her condition being still good, the molasses was reduced to once a day, 2 lb. in local chaff, all the turnips being finished. The cow calved 25th October, the calf being strong and healthy. At 31st October she was in good condition but not giving much milk (one quarter being dry), only 20 lb., finished feeding molasses. At 10/3/24 condition still good; giving 16 lb. milk daily; apparently in calf.

"*Daise*," Shorthorn four-year-old light roan. Arrived at farm 6/7/21; calved 15th September. At 1st October giving 41 lb. milk, 1st November, 42 lb., 31/1/22, 32 lb.; 28th February, 20 lb., 30th March, 15 lb., 30th April, 10 lb. At 1st May rugged and given meadow hay. At 15th May looking well and being milked once a day. Commenced feeding turnips, two hours each day. Has looked well all the time, and at 31st October was in excellent condition and springing. Calved on 10th November, at 30th November giving 40 lb. milk, looking better than when she calved last year, but not milking so well. At 1/2/23 condition good, but a little dry in coat, giving 30 lb. milk. At 1st March giving 25 lb., put to bull on same date. Giving 2 gallons at 1st April. Put to bull again 5th May. Going back in condition, although on hay and turnips, remained in stationary condition to 30th September, getting hay and turnips all the time, when an improvement was noticeable, eye brighter and better skin. At 30th October was looking well. On 1/1/24 gave birth to strong healthy calf. Cow in good condition, but not milking so well. At 10th March giving 24 lb. milk daily. Apparently again in calf, still healthy.

"*Brier*," grade Shorthorn, dehorned, six years old. Arrived 6/7/21, calved 15th October (calf died 21/3/22). Giving 40 lb. milk and improving at 1st November, 30 lb. at 30/1/22; 18 lb. at 25th February; 10 lb. at 30th March, 12 lb. at 30th April. At 1st May rugged and started on meadow hay, at 15th May looking well and milking once a day. Started running on turnips two hours a day. At 30th June was looking well, dry on 31st August, was found to be empty, but in excellent condition. At 1/1/23 looked well, but appeared stiff all over and developed a curious stiff-necked habit when feeding. Although in excellent condition, was slaughtered and found to be suffering from spinal tuberculosis.

"*Lily*," light roan Shorthorn, dehorned, seven years old. Arrived 6/7/21; calved 15th October. At 1st November was giving 35 lb. milk, and in good condition; 30 lb. at 30/1/22, 20 lb. at 28th February; 18 lb. at 30th March; 12 lb. at 30th April; 12 lb. at 1st May, when rugged with sack cover and started on meadow hay. At 15th May was milked once a day. At 12th June was run on turnips two hours a day, and progressed well until 15th July, when appeared tucked up in stomach. Continued in the same condition until 17th October, when she calved; calf dead. Cow going back fast, with first signs of bush sickness; giving 12 lb. of milk on 31st October. Was moved to Tirau on 2nd November and brought back in good condition on 17th March. On 25th March was served by bull, and by 1st May had greatly improved since being brought back from Tirau.

On 20/5/23 commenced giving 2½ fl. oz. iron and ammonium citrate in local chaff twice daily, the cow being in good condition. At 1st June was getting in addition hay and turnips. On 15th September commenced to feed once a day, instead of twice, 3 fl. oz. of Ferri. Ammon. Cit. in local chaff; finished feeding turnips. At 30th August cow was in first-rate condition; at 15th October finished feeding out medicine, the animal being beef. At 1/1/24 cow calved, a good strong calf. At 10th March, milk 27 lb. daily; apparently again in calf.

"*Ginger*," bright-yellow Jersey six-year-old. Arrived 6/6/21; calved 25th September. At 1st October giving 34 lb. milk, and had improved in condition; at 15th October, 30 lb. At 16th October commenced to drench with phosphoric acid, 30 c.c. daily. Finished drenching at 24th December for a time;

cow doing well. At 28/2/22 cow looking well, and giving 15 lb. milk. At 30th March 12 lb. milk, when commenced to feed locally grown chaff with a daily dose of phosphoric acid mixed with it. At 30th April looking well and giving 10 lb. milk. Was rugged and given meadow hay at 1st May. At 15th May was looking well; dry. At 12th June was given turnips for two hours each day. Looking well up to time of calving, 23rd August. Calf weakly and not expected to live, and was destroyed. Cow continued in good condition, but during September lost condition, although still getting turnips and hay with medicine and chaff, which she took readily; giving 25 lb. milk. At 31st October gave 30 lb. milk, but showed signs of bush sickness. At 1st December was steadily losing condition, stopped feeding medicine, as she would not take it readily; giving 22 lb. milk.

Commenced giving potassium iodide twice daily, mixed in table-salt, 1 oz. with salt making eight doses. On 22nd December left off drenching, as no improvement effected and animal continued to go back in condition; giving 15 lb milk at 1/1/23.

Commenced at 15th January to drench with 3 fl. oz. of iron and ammonium citrate, made from Cook Island limes, twice daily. At 1st March cow had not improved in condition much, but milk increased in quantity, milking once a day giving 15 lb. Commenced drenching with 3 fl. oz. of the commercial Ferri Ammon. Cit. twice daily. Started to improve in condition at 15th April. At 6th May improving, and milking once a day. At 20th May commenced giving 24 fl. oz. Ferri. Ammon. Cit. in local chaff twice daily, cow improving daily at 1st June. Getting hay and turnips; still slowly improving at 20th June. Later quite recovered from bush sickness, and getting plenty of hay and turnips. At 15th September commenced giving 3 fl. oz. of commercial Ferri. Ammon. Cit. in local chaff once a day; turnips finished. At 15th October condition was good, finished feeding out the medicine. Due to calve again in May this year. At present in perfect health.

"Rose," a red-and-white Shorthorn six-year-old dehorned cow. Arrived on farm 6/7/21; calved 3rd October. Improved in condition and gave 6 lb. of milk at 1st November, 30 lb. at 30th November. At 10th December started to drench with phosphoric acid, 30 c.c. daily, which was finished at 24th, when she was looking well; but doubtful if this was due to good food or to medicine. At 28/2/22 she was giving 15 lb. milk and looking well. At 30th March she was given 30 c.c. of phosphoric acid in about 6 lb. of locally grown chaff, then giving 13 lb. milk, which was reduced to 10 lb. during April. On 1st May she was rugged with a sack and started to feed on meadow hay, and on 15th she was milking well once a day. On 12th June she started to run on turnips two hours each day. At 30th June she was dry and looking well. At 15th July she started to scour, so medicine was stopped for a few days. She was now falling away in condition and not cleaning up her feed. At 31st July she was still scouring, dull about the eye and not looking well. At 31st August she had recovered from the scouring, but exhibited every appearance of commencing bush sickness. At 27th September there was no doubt of this cow being bush-sick. She refused to take her medicine. At 8th October had trouble in calving; took dead calf away on 9th. On 10th cow died through condition being impaired by bush sickness.

"Melba," spotted Ayrshire Shorthorn twelve-year-old. Arrived at farm 6/7/21; calved 21st December with twin calves, dead. At 1/1/22 giving 30 lb. milk; at 1st February improving in condition and giving 40 lb. At 28th looking well and giving 25 lb. At 30th March looking well but not putting on as much condition as other cows; giving 20 lb. At 30th April losing condition a little; giving 10 lb. At 1st May rugged and fed on meadow hay. At 31st looking well and milking once a day. At 12th June commenced running on turnips two hours a day and did well up to 15th July, when she was falling away slightly and continued milking once a day. Weather rough. Cow empty. At 27th September cow dry, and appeared to be losing condition, although still feeding on hay and turnips until 31st October, when she was showing signs of bush sickness. At 2nd November she was taken to the Tirau paddock, and brought back on 17/3/23, looking healthy but not in good condition. At 1st April she was improving, and at 1st May looking well. At 20th she was given 24 fl. oz. of Ferri. Ammon. Cit. scales in local chaff twice daily, and was then in fair condition; her condition had never been really good. At 1st June she was getting turnips and hay, but her condition was still only fair; this was continued to 15th September, when commenced to feed medicine once a day instead of twice, and the turnips were finished. Medicine

was finished on 15th October. She was still in the same state at 30th, never having put on condition in spite of five months' medicine. At 4/1/24 calved; calf strong and healthy; cow a wreck, and died on 12th from old age and bush sickness.

"*Queenie*," Jersey dehorned seven-year old. Arrived at farm 6/7/21. At 5th September was given 1 lb. of molasses in 3 lb. of local chaff twice daily. At 1st October she was improving in condition and giving 33 lb. milk. At 1st November she was looking well and giving 42 lb. At 15th molasses feeding was stopped, as there was too much grass for her to take the dry food. At 30/1/22 she was looking well and giving 30 lb. milk, at 28th February, 15 lb. At 30th March commenced feeding her again with molasses, getting 13 lb. milk; at 30th April 6 lb. At 1st May she was rugged with sack cover and started to feed on meadow hay. At 31st she was dry; appetite not so good; still taking molasses in dry food but inclined to leave it. At 12th June commenced running on turnips, two hours each day. At 30th she refused to take any food with molasses in it. At 15th July was losing condition; at 31st eyes dull, hollow flanks, signs of bush sickness. This cow had refused to take molasses and chaff about the middle of June, since when she had it only at intervals three days a week. The ration of molasses was reduced from 1 lb. to $\frac{1}{2}$ lb. daily in order to induce her to take it. At 31st August the cow refused to take the molasses, and was rapidly falling away at 30th September, although still taking turnips and hay. At 15th October she calved; the calf was too weak to live, and the cow died.

"*Polly*," a dark Jersey eight-year-old dehorned cow. Arrived at farm 6/7/21; calved 14th August; calf born dead. At 5th September commenced feeding 2 lb. bran in 3 lb. local chaff twice daily. At 1st October was improving and giving 32 lb. milk. At 1st November looking well and giving 40 lb. At 15th, there being too much grass, stopped feeding. At 30/1/22 she gave 30 lb., and at 28th February 20 lb. milk, and was looking well. At 30th March the bran feeding was recommenced; now giving 12 lb. milk. At 1st May she was rugged and started on meadow hay; at 31st milking once a day. At 12th June commenced running on turnips two hours daily; at 30th she was dry and looking well. At 31st August she was still looking well, but backward in springing. At 30th September was in excellent condition, and at 30th October springing a little and still in excellent condition. At 30th November stopped feeding bran. At 20th December cow calved; calf strong and healthy, cow in excellent condition. At 1/1/23 not milking quite as well as previous year, although in better condition, giving 25 lb. milk. At 1st February was losing condition and showing first symptoms of bush sickness; giving 25 lb. milk. At 1st March slowly going back in condition; giving 20 lb. At 15th March commenced drenching with 3 fl. oz. of commercial Ferri. Ammon. Cit. twice daily. At 1st April condition was improving. At 20th May commenced giving 2 $\frac{1}{2}$ fl. oz. Ferri. Ammon. Cit. in local chaff twice daily; cow showing slight improvement. At 1st June getting hay and turnips; not much change in condition. At 1st July little improvement, at 1st August looking a little brighter; at 1st September improving in condition. At 15th September feeding reduced to once a day—that is, 3 fl. oz. of commercial Ferri. Ammon. Cit. in local chaff. Turnips by now all finished; at 30th September improvement maintained. At 18th October cow calved; calf thin and weakly. At 23rd October milk yield was 18 lb.; at 31st 29 lb. At 10th November finished feeding on Ferri. Ammon. Cit.; cow now in really good condition and completely recovered from bush sickness. At 10/3/24 yield of milk 23 lb. daily; condition first rate; again in calf.

NOTE.—The dosage of commercial Ferri. Ammon. Cit. is in each case given as fluid ounces of a 6-per-cent. solution of the scales. In the case of the home-made citrate solution, different lots of which varied somewhat in strength, the dose specified was in each case equivalent to 2 fl. oz. of the 6-per-cent. solution above-mentioned.

TREATMENT OF CALVES.

Spring of 1921.

Three of the calves of the before-mentioned cows were all given the following treatment: 1 gallon of new milk night and morning for the first fortnight; $\frac{1}{2}$ gallon of skim-milk in $\frac{1}{2}$ gallon of whole milk

for the next fortnight, night and morning; $\frac{1}{2}$ lb. meal (4 lb. barley-meal, 2 lb. bran, 1 lb. linseed) fed in the milk for the next three weeks; and then $\frac{1}{2}$ lb. meal fed dry after having had milk, with $\frac{1}{4}$ lb. molasses added. The calves were weaned at about six months and put on young grass. In other calves the treatment was varied by omitting the molasses. At the time of weaning the three calves which had had molasses were quite the best of the ten treated, there being little difference between the other seven. All of this season's calves, however, were found to be affected with lungworm, and all died at various dates subsequently.

Spring of 1922.

The calves born alive in the spring of 1922 were as follows: Dam "Brindle" (second calf)—a white-faced Hereford bull, 1st September; dam "Te Kuiti"—a fawn Jersey heifer, 6th October; dam "Daisy"—red bull, 19th November; dam store heifer—Shorthorn-Jersey heifer, 20th August.

These calves were given the following treatment:—

"Brindle's" second: 1 gallon of milk for first fortnight, night and morning; $\frac{1}{2}$ gallon whole and $\frac{1}{2}$ gallon skim milk for next fortnight; 1 gallon skim-milk and $\frac{1}{2}$ lb. mixed meal (made as above) scalded and fed in milk for next two months; and then had $\frac{1}{2}$ lb. meal daily with $\frac{1}{4}$ lb. molasses after having milk. He was turned out on to new grass when weaned, about six months.

"Te Kuiti's" calf was given the same treatment as "Brindle's" second calf, but had crushed oats instead of mixed meal, and no molasses. At 10th May a little Ferri. Ammon. Cit. scales was given in milk twice daily up till 30th September, when the treatment was discontinued.

"Daisy's" and the store heifer's calves were given exactly the same treatment as "Te Kuiti's." The condition of all these four yearlings was good at February, 1924, when the photo (Fig. 4) was taken.

Spring of 1923.

These (Fig. 5) calves had the usual milk treatment—whole milk during the first month; an equal mixture of skim and whole milk in next month; and then a special treatment additional to the mixed milk as described for each calf.

"Brindle's" third calf; born 4th November; strong red Shorthorn bull with a little brindle on back; $\frac{1}{4}$ lb. molasses per day added to the milk.

"Polly's" third; born 26th October; a thin weedy red heifer with white legs; 1 fluid ounce of iron and ammonium citrate (home-made) per day added to the milk.

"Darkie's" third; born 16th November; a strong brindle Shorthorn bull; same treatment as "Polly's" calf.

"Cherry's" third; bull with white on face; born 17th October; strong and healthy; $\frac{1}{4}$ oz. iron and ammonium citrate (commercial) per day to milk.

"Maud's" third; heifer, partly brindle; born 28th October; strong and healthy. Control.

"Daisy's" third; born 1st January, 1924; strong and healthy light roan heifer. Control; no treatment to milk.

These treatments were still being carried out at 26th March, 1924.



FIG. 4. YEARLINGS FROM COWS SOME YEARS ON FARM, PREVIOUSLY UNSUCCESSFUL IN REARING CALVES.

The white-faced calf is "Brindle's" second calf, the Jersey heifer, "Te Kuiti's" second, the red-and-white bull, "Daisy's" second, the Shorthorn-Jersey on far side of fence is the "store heifer's" calf. Photo taken in November last.



FIG. 5. SOME OF THE 1923-24 SEASON'S CALVES.

Those in the foreground, reading from left, are out of "Polly," "Darkey," "Cherry," "Maud," and "Brindle." Photo taken in February, 1923.

Six calves from new cows are at date of writing between six and seven months old, and all healthy (see Fig. 6): (1.) Dam "Fanny"

—white bull; good strong constitution; no treatment to the milk. (2.) Dam "Jean"—one bull, in centre of photo with back to camera, and one on extreme right, dam "Mona" (both showing signs of scouring), are calves on molasses treatment to the milk, $\frac{1}{4}$ lb. night and morning, are in better condition than any of the three lots; weaned 1st February, 1924. (3.) Dam "Spot," calf on left, and dam "Beauty," calf on right, the two other calves facing camera, are on citrate-of-iron treatment and are in good condition; they had $\frac{1}{2}$ fl. oz. home-made Ferri. Ammon. Cit. in milk, night and morning. (4.) Very small calf (behind white calf) refused to take milk and is dwarfed. N.B.—The rest had whole milk for two months instead of one.

At the time of taking the photo—February, 1924—the white calf was in the poorest condition, although when born she was the strongest. "Spot's" calf is a little larger, though not in such good condition as the molasses calves. Both weaned 1st February, 1924. "Beauty's" calf is in good condition.

RECORD OF CALVES BORN AT MAMAKU FARM OUT OF EXPERIMENTAL DAIRY COWS

Dam.	Date Cow arrived on Farm.	First Calf.		Second Calf.	Third Calf.
		Born.	Died.		
"Brindle"	6/7/21	8/8/21	Ten months ..	Survived ..	Survived.
"Brier" ..	6/7/21	15/10/21	Five months ..	Dam killed*	..
"Cherry"	5/9/20	1/11/20	Destroyed at birth.	Slipped calf	Survived.
"Daisy" ..	6/7/21	5/9/21	Killed (lungworm)	Survived ..	Survived.
"Darkie"	6/7/21	29/7/21	Eight and a half months	Born dead ..	Survived.
"Ginger"	6/6/21	1/10/21	Seven months ..	Destroyed ..	Not calved yet.
"Lily" ..	6/7/21	15/10/21	Seven months ..	Born dead ..	Calf destroyed at birth; strong.
"Maud" ..	6/6/21	26/8/21	Born dead ..	Born dead	Survived.
"Nigger"	27/10/20	29/4/21	Cow died ..	..	..
"Polly" ..	6/7/21	14/8/21	Born dead ..	Destroyed at 2½ months	Survived.
"Queenie"	6/7/21	..	Calf and cow died	..	..
"Roanie"	6/7/21	20/8/21	Nine months ..	Slipped calf	Slipped calf.
"Rose" ..	6/7/21	3/10/21	Six months ..	Born dead ..	Cow died.
"Te Kuiti"	22/3/22	6/10/22	..	Survived ..	Slipped calf.
"Melba" ..	6/7/21	21/12/21	Twin calves died	Cow empty	Cow died; calf destroyed; healthy.

* Tubercular.



FIG. 6. CALVES BORN IN AUGUST, 1923, OUT OF NEW COWS WHICH ARRIVED AT THE FARM ON 2ND JULY.

On extreme left, calves out of "Spot" and "Beauty" which received citrate-of-iron treatment; red-and-white calves out of "Jean" and "Mona," molasses treatment, white calf out of "Fanny," control. Photo taken in February last.

RETROSPECT.

In considering these experiments with dairy cows one should notice the diverse breeds of the cows employed. Friesian, Jersey, Ayrshire-Hereford, Jersey-Shorthorn, Shorthorn, Ayrshire-Shorthorn, all the common milking breeds and crosses, are here represented, and in the case of "Cherry" there was a considerable strain of a beef breed (Hereford). Regarding the influence of breed on the incidence of bush sickness, in the light of the present limited experience little can be said, but it looks as though the undiluted Shorthorn breed had been rather unfortunate in these experiments. Out of sixteen cows, six were Shorthorn; one of these was slaughtered as tubercular, one died, and one was discarded as unsuitable. Of the whole six only one raised a healthy calf in three years.

Medium-aged cows, from six to eight years, are probably the best to introduce for bush-sick country. Heifers have not enough constitution, neither have aged cows, to withstand the extraordinary conditions.

Regarding the different treatments, it is evident that neither bran nor linseed feeding have had anything more than a temporary effect on the dairy cattle. Linseed puts a good coat on the animal for a time. Bran is also good for a time if enough be given, but its dryness hinders the continuous administration when there is plenty of grass available. After all it is practically a foodstuff imported into the district, very rich in phosphates, and the effect of phosphates has been determined to be at first beneficial. Such foodstuffs given in addition are, of course, remedial to a certain degree if grown on country free from the sickness.

Molasses certainly labours under the same criticism that it is an imported foodstuff of mixed mineral or ash content, but it is a cheap by-product—really a waste product in both the cane and the beat-sugar manufacture—and if larger supplies became necessary they could no doubt be obtained at a greatly reduced price. The method of feeding molasses recommended in Europe is to mix it with hot water and pour the solution over the dry food and well mix the two. Scouring generally follows its use as a food, but Kellner states that it is possible to avoid this by gradually introducing it in increasing quantities to the dry food until the maximum of 2½ lb. for cows, 4 lb. for fattening bullocks and sheep, and 5 lb. for pigs is reached. Animals in an advanced state of pregnancy are said to show a tendency to abortion when molasses is fed. The action of molasses in combating bush sickness in stock may be due to one or all of the following causes: (1) It may act as a food, increasing the general nutrition; (2) it may supply certain mineral foods deficient in the natural ration, or correct the balance of the mineral ration; (3) it may, by its antiseptic or purging effects, alter the digestive mechanism of the ruminant and enable it to assimilate more of the iron present in the pasture, hay, or artificial food.

That molasses has such a beneficent influence on bush sickness makes the administration of iron salts a very much easier matter than if drenching were always necessary. The bought iron compound may be dissolved in hot water mixed with molasses and more hot water, and sprinkled on hay or the dry feed. But if a quick recovery is desired the home-made medicine may be made from lemon-juice, precipitated iron hydrate, and ammonia, mixed with molasses, stored, and given as required. In hot weather the diluted molasses may ferment, but in the cooler months fermentation is unlikely at the elevation of Mamaku.

A point that should not be lost sight of is that all those cows which with appropriate treatment in their third year raised healthy calves had lost their calves in the first year, and in the second year all but two had lost them. All these cows (except "Brindle"), which at the time of writing are healthy, have been bush-sick and have been brought round by treatment, so that it cannot be said that anything but the treatment has enabled them to regain their health and to keep it. With regard to "Brindle," a naturally strong-constitutioned cow, her first calf survived to the age of ten months, and it is possible that the dam would have gone bush-sick but for the treatment, in spite of her strong constitution.

The administration of iron and molasses consecutively gave excellent results with "Darkie" and "Cherry" when linseed had previously failed. The iron treatment alone was good in "Te Kuiti's" case, but owing to the treatment being stopped at a critical time she lost her calf. Mr. Jackson thinks that this was owing to the stoppage of the iron treatment. Molasses and turnips were responsible for "Brindle's" excellent performance—two calves in consecutive years, both healthy and surviving, and the dam healthy throughout the whole time. Molasses failed with "Queenie," who refused to take it with her food, but probably was the cause of "Maud's" success after a change. Bran alone was a failure, but after a change molasses enabled a healthy calf to be reared by "Roanie," previously treated with bran. Bran succeeded for a time with "Polly," and enabled her to produce



FIG. 7. COW "BRINDLE," OF THE EXPERIMENTAL HERD.

This animal is outstanding as having healthily reared two consecutive calves (one to the yearling stage) without leaving the farm.

a calf which survived for two and a half months and then had to be destroyed, while the dam had to be brought round by iron treatment, her subsequent calf surviving. Phosphoric acid failed to show any permanent benefit to "Ginger" and "Rose." Turnips and good feeding were no doubt responsible for "Daisy's" freedom from sickness, but failed with "Lily" and "Melba."

From a perusal of these cases it will be seen that the iron and ammonium citrate treatment gives the most positive results, but it is quite likely that with a more extended experience molasses treatment may prove efficacious.

It is, of course, open to objectors to urge that there was something exceptional in the season of 1923-24 which enabled the grass to have greater nutritive qualities. This can only be negated by continuing the experiments over a term of years, so eliminating seasonal influence.

CURRENT WORK AND PROSPECTS.

Experiments are being conducted with sugar bricks containing the maximum amount of iron and ammonium citrate which it is possible to get an animal to lick. This is a concentrated form of medicine and may be put into the feed-box for the cows to lick during the limited time they are in the bails each day while being milked. Such a lick must, of course, be kept away from the weather, as the sugar is extremely soluble in water (far more so than salt) and would soon be washed away by rain. Cattle show a great avidity for such a lick, which is made up in a pressed form and is extremely hard and dense. Experiments at Mamaku have shown that the difficulty of automatically giving iron in lick form has hitherto arisen from the unwillingness of the animal to partake of the astringent-tasting compound when it is mixed with salt. The difficulty is now likely to be in the contrary direction when used in the open field; the excessive desire of the stock

to take the sugar lick will have to be combated by mechanical devices, such as a series of lick-boxes so arranged that each animal gets its own share, otherwise the stronger animals will monopolize and consume all the lick.

As to the cost of the iron and ammonium citrate, the price is now much lower; although at one time as high as 16s. 6d. per pound it can now be obtained in 1 cwt. lots in London for 2s. 9d. per pound. Further, this is a case in which an increasing demand would considerably cheapen the supply. The growth of lemons and limes could easily be carried out on a large scale at Tauranga and Te Puke, on the margins of the bush-sick area. Limes contain much more citric acid than lemons. The citric acid is the dearest constituent of the three, being about 2s. 6d. per pound; the ammonia is about 1s. per pound, and the iron a few pence. Thus, if the citric acid (32 per cent.)—the most expensive ingredient to buy—is grown locally, the ammonia (52 per cent.) will be the only expense to seriously consider: this can be obtained for 1s. per pound, and the cost of the iron (16 per cent.) is negligible. Large quantities of citric acid or a salt of this are either manufactured or wasted from surplus or bad fruit in every citrus orchard.

The prospect for the successful utilization of pumice lands now classed as bush-sick would seem to be reasonably bright, but there is much room for careful research work of all kinds—at the Mamaku Demonstration Farm, on the farmer's lands, and at the Chemical Laboratory, at Wellington. The writer has interested the Lands Department in the matter, and a topographical survey of the Rotorua County is in progress, which it is hoped will be extended to the poorer pumice lands beyond that county. A topographical map is of the utmost importance in connection with a soil survey of the district, which is at present being carried out.

The Mamaku Farm has been fortunate in having the management of Mr. R. A. Jackson, the late owner of the property, who has an intimate knowledge of the district, and has always been keenly interested in testing theories concerning bush sickness, and unsparing in his efforts towards finding a solution. Mr. R. Alexander, Stock Inspector, Hamilton, for some years was most instrumental in purchasing stock for the farm when required, and also in exercising supervision over it. Mr. H. Munro, District Inspector, Auckland, has since 1st April, 1921, taken over the supervision, and has been very successful in suggesting and initiating new methods of working. Mr. J. Lyons, M.R.C.V.S., District Superintendent, Auckland, has had the professional supervision of the live-stock, while the investigation as a whole has been under Mr. A. R. Young, Director of the Live-stock Division, Wellington. Under Mr. Young's direction the Mamaku Farm, from being a collection of rather dilapidated sheds surrounded by rough pasture and stumps, has evolved at comparatively small expense into a well-ordered business-like dairy farm, with subsidiary branches and 65 acres of land under crop or temporary pasture.

In next month's *Journal* the writer hopes to deal with the more scientific side of the question, and give some account of the laboratory work.

THE "TURNIP-FLY" AND ITS ASSOCIATES.

"FLY" PROVED TO BE THE GRASS-GRUB BEETLE.

DAVID MILLER, Entomologist, Biological Laboratory, Wellington.

OF the crops most intimately associated with animal husbandry in New Zealand turnips and rape are perhaps the most outstanding and universally cultivated, but they are more or less severely assailed by disease and insect depredations. Among the insect pests one of the great drawbacks to successful turnip-growing is the so-called "turnip-fly," considerable areas of turnips in most parts of the Dominion being annually laid waste during the seed-leaf stage, necessitating one or more resowings of the crops. Prior to the investigation of this problem last spring nothing definite had been established as to the identity and nature of the insect or insects responsible, and the term "turnip-fly" has been universally used by farmers with reference to the trouble.

THE "FLY" AND ITS HABITS.

The reports of damage from various turnip-growing districts of the Dominion showed that most of the loss occurs during November and early December, when considerable areas of turnips are in the first leaf. This pointed to the probability of the grass-grub beetle (*Odontria zealandica* White), notorious for its depredations upon the foliage of various plants such as orchard-trees, willows, &c., being the culprit, since at that period of the year large swarms of the beetle are on the wing. Subsequent observations proved this to be the case, although other factors were found responsible for part of the damage.

The attack of the "fly"—the grass-grub beetle—is confined to the above-ground portion of the plants affected, and practically any crop in the seed-leaf stage during the flight of the beetle is liable to destruction. In many districts the damage to rape is just as serious as to turnips, but the former grows more rapidly and has better chances of recovery. At times the seedling crop is damaged only within half a chain or so of headlands, particularly in the vicinity of hedgerows and tall grass (Fig. 1); but though the beetle is responsible for this to a certain extent it is mostly the work of the cutworm, which will be dealt with later. The characteristic feature of the beetle infestation is that the whole crop is completely destroyed or large patches are eaten out over the whole area (Fig. 2). The injured individual plant shows that the seed-leaves and stalk may be completely destroyed, nothing being left but the underground portion, or one or both of the seed-leaves may be partly or wholly removed from the stalk. The effect of the beetle on crops in full leaf is not so noticeable, as there is more leaf-surface to come and go on, but the attacks are nevertheless apparent, and may even result in more or less complete defoliation. The beetles eat the leaves along the edges, so that the latter, if not destroyed, are noticeable on account of their serrated appearance.

The beetle (Fig. 3), as mentioned, is on the wing during November and the first three weeks of December each year, though it may be active in smaller numbers during the latter part of October and into January.

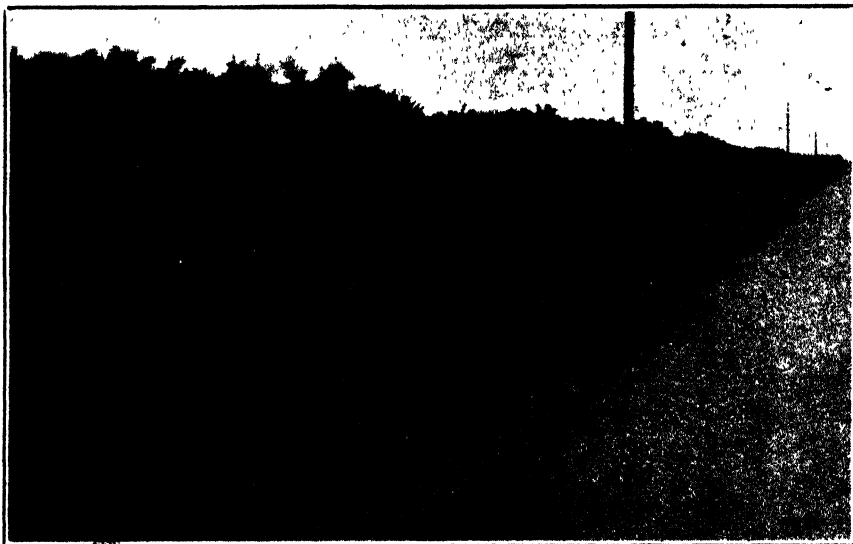


FIG. 1. A CHARACTERISTIC FEATURE OF THE TURNIP-GROWING AREAS: HEDGEROW AND RANK GRASS WHERE INJURIOUS INSECTS SHELTER AND BREED.

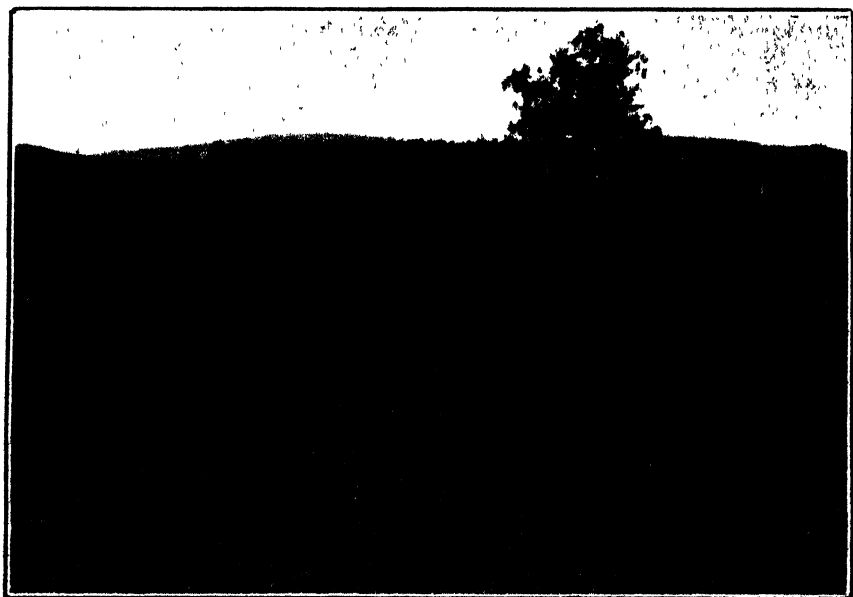


FIG. 2. A YOUNG TURNIP CROP AT AMBERLEY ATTACKED BY THE "FLY."

[Photos by F. E. Ward.]



FIG. 3 (ON LEFT). GRASS-GRUB BEETLE (*ODONIRIA ZEALANDICA*)—THE SO-CALLED "TURNIP-FLY." $\times 2\frac{1}{2}$.

FIG. 4 (CENTRE). GRASS-GRUB—THE LARVA OF *O. ZEALANDICA*. $\times 4$.

FIG. 5 (RIGHT). PUPA OF GRASS-GRUB. $\times 4$.

[Photos by E. B. Levy.]

It is nocturnal, flying usually close to the ground at dusk, when it creates the droning sound characteristic of its activity. During large flights the beetles may be seen skimming over pasture. Later in the evening they settle upon turnip and rape crops and other vegetation and commence to feed, and it is thus during the night that young crops are destroyed.

On the approach of daylight the beetles cease feeding and seek shelter among the denser foliage of plants, or burrow into the ground whether covered or not by pasture. Numbers of dead beetles are often turned up when cultivated land is ploughed after large flights. In the case of roughly cultivated or stony ground the clods or other objects strewn the surface act as shelter during the day. The insect is not so active on bright moonlight nights or during windy weather, but is most lively during dull, mild, and calm evenings.

The female beetles entering the ground do so not only to shelter but also to lay the eggs. These are spherical, glistening-white, and about the size of a pin's head. Though usually laid in ground well stocked with roots, such as pasture, the eggs are not infrequently placed in the comparatively bare ground carrying a turnip or rape crop, with the result that the grass-grubs (Fig. 4) on hatching concentrate upon and devour the tender roots, a considerable check to the developing crop taking place. In the case of turnips particularly, the bulb itself is frequently attacked (Fig. 6), and although many of the attacked plants are noticeably unhealthy the greater proportion as a rule are able to recover by throwing out new roots. This type of damage is prevalent in young crops from December to March. A characteristic feature of grass-grub infestation is the pulverization of the surface-soil, which becomes quite spongy in extreme cases. On the approach of winter the grass-grubs cease feeding and burrow downwards, each constructing an earthen cocoon in which to hibernate. Activity recommences at the surface during August, when the grubs become fully grown. During September a great number, and in October practically all, have again descended and constructed cocoons for the second time. In these cocoons pupation (Fig. 5) takes place, and the van of the main November and December flights of beetles is on the wing by the end of October.

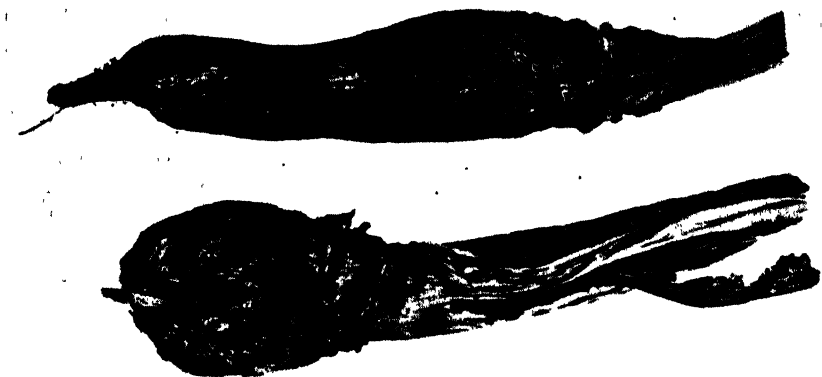


FIG. 6. ROOTS OF YOUNG TURNIPS ATTACKED BY GRASS-GRUB.

[Photo by H. Drake.]

CONTROL.

The key to control should be one of avoidance. As it is not practicable to stop the flight of beetles, since they are widely distributed throughout the country and their grubs breed in ground stocked with the roots of grass—both native and sown—and of many other natural and cultivated plants, the process of control lies in regulation of the sowings of turnip and rape so that as few crops as practicable will be in the seed-leaf stage during the beetle flights. That is, in order to avoid damage the crops should not be sown till after this period, or should be sown sufficiently early before the flights to be so far developed in the second leaf as to be able to withstand attack. Since the beetle's most destructive period is during November and the first three weeks of December, crops sown in October are sufficiently advanced to be free from serious injury later. Sowings made during November and the first half of December are likely to be most seriously damaged and often destroyed. From the last week in December onwards crops can be started with safety, though minor attacks occur by late-flying beetles. Owing to the absence of crops on bare ground the beetles will not be attracted thereto except to a limited extent for sheltering purposes. In consequence, such ground being free or practically free of eggs, the chances of root-injury by grubs to subsequent crops will be proportionately lessened. Where early crops have been sown in October, prior to beetle-flight, there will, of course, be a considerable amount of egg-laying in such occupied land, but the crop will be at that period both far enough advanced in leaf and root development to withstand leaf attack by the beetle, and to a great extent root-attack by the grubs shortly after.

Though the November-December period during which crops are likely to be seriously damaged holds good throughout New Zealand,

there are slight variations. For example, in certain parts of Canterbury toward the foothills fly activity does not generally become seriously apparent until the last week in November, and continues to the third week of December; while along the coastal districts from North Canterbury to Otago extensive damage is wrought from the beginning of November till the first fortnight of December. In Southland, again, owing to the comparatively late beetle emergence, the crops as a whole are well advanced in the second leaf before the attack commences. In the North Island the November and early December period holds throughout with but little variation; in Taranaki, for example, the 1923 flight occurred throughout November, and was practically over by 12th December.

Naturally one of the greatest aids to successful crop-development in the presence of insect-depredations is the establishment of vigorous crops, and one of the serious and too-common hindrances to such is poor cultivation. Roughly cultivated land not only affords attractive and easy shelter for the beetles, but also retards the growth of crops grown therein. Under such conditions crops sown even early enough before beetle-flight may not develop sufficiently in leaf to withstand assault, and certainly are very likely to suffer from attack by the grubs owing to tardy development of the root-system. Late winter and early spring cultivation of land has a beneficial and direct effect to a certain extent on the control of the grubs, since the nearly mature grubs are exposed on the surface and devoured by birds, which almost invariably follow the plough. Mr. J. G. McKay, of the Ashburton Experimental Farm, stated that when ploughing to a depth of 5 in. during August enormous numbers of the beetle grubs were turned up and devoured by swarms of sparrows. In this respect starlings are also helpful, and will dig up the grubs from infested ground when the insects are active near the surface. However, though great numbers of grubs must thus be destroyed and as many adult beetles prevented from developing, the general effect on the fly situation is but limited, since beetles sufficient to carry on destruction develop in the extreme areas of neighbouring uncultivated land. A common practice in Canterbury is to light fires at night in order to attract and destroy the beetles, but such a method gives but an unsatisfactory control at best.

The grass-grub is apparently comparatively free from insect enemies, though predaceous subterranean larvæ of various insects no doubt prey upon it. One type of such was found to do so, this being the larvæ of two species of native robber-flies. These larvæ (Fig 7) are more or less maggot-like in colour and shape, but much longer, and have delicate white hairs projecting from the rather large terminal segment. When fully grown they transform in the ground to pupæ (Fig. 8), and the adult flies finally emerge therefrom and leave the ground. The flies are two-winged insects, and are known as "robber-flies" from their habit of capturing other insects and sucking them dry. They are long and narrow bodied; the larger (*Itamus varius*) measures about $\frac{3}{4}$ in. long and is black (Fig. 9); the smaller (*Sarapogon antipodius*) is about $\frac{1}{2}$ in. long and is reddish with black and yellow markings (Fig. 10). The larger captures such insects as the house-fly, stable-fly, and even the honey-bee.

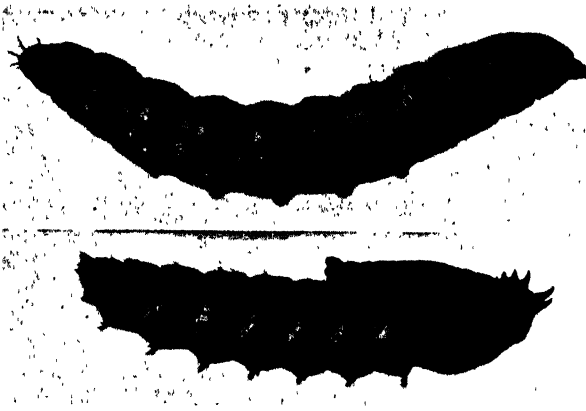


FIG. 7. LARVA OF THE SMALLER ROBBER-FLY (*SARAPOGON ANTIPODUS*), AN ENEMY OF THE GRASS-GRUB. $\times 2\frac{1}{2}$.

FIG. 8. PUPA OF *S. ANTIPODUS*. $\times 2\frac{1}{2}$.



FIG. 9. THE LARGER ROBBER-FLY (*ITAMUS VARIUS*). $\times 2$.

FIG. 10. THE SMALLER ROBBER-FLY (*SARAPOGON ANTIPODUS*). $\times 2$.

[Photos by H. Drake.]

THE CUTWORM.

Reference has already been made to seedling turnips being injured in the characteristic "fly" manner along the headlands of fields. Unlike the beetle-attack, such injury is not restricted to the November-December period, but appears among the earliest-sown crops. It is the work of the "cutworm," the blackish caterpillar of a moth (Fig. 11).^{*} A feature of this phase is that such damage is most prevalent in the

^{*} The commonest species of cutworm found attacking turnips is *Agrotis ypsilon*, but another species is *Ariathisa coma*. The former was abundant in Taranaki, while the latter was reared from material brought from Otago and Southland.

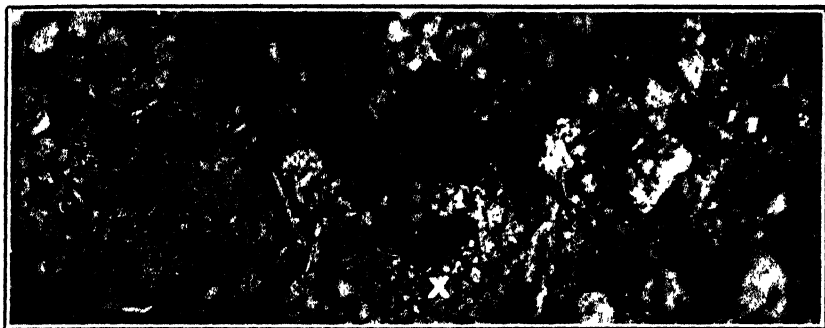


FIG. 11. CUTWORM () AT WORK ON YOUNG TURNIP-PLANT.

Photo taken by flashlight at 11 p.m.

[Photo by F. L. Ward.]

FIG. 12. PUPA OF CUTWORM. $\times 2$.FIG. 13. PARENT MOTH OF CUTWORM (*AGROTIS YPSILON*). SLIGHTLY ENLARGED.

[Photos by H. Drake.]

vicinity of hedgerows and coarse grass. This is to be expected, since it is in such places that the moths shelter and lay their eggs, and the caterpillars feeding upon the grasses migrate on to a crop as soon as it appears above ground. These caterpillars are nocturnal, and during the day are usually found just beneath the surface of the ground curled up at the roots of the plants attacked the night before; as a rule there is a single caterpillar to one plant. When in the seedling stage turnips, and practically any other crop just above ground, are completely devoured, the stems being nipped off close to the ground. The injury, though most apparent in early growth, is not confined to it, but may continue throughout the life of the plant. At later stages of growth a leaf-petiole is eaten through, so that the leaf falls to the ground and is there devoured. The cutworm is a ground feeder, and very often drags a leaf or a portion of it underground into its resting-place. Damage to turnips when well formed is not apparent on the foliage, but is very marked on the root itself where it stands above ground, in many cases the cutworm having "ring-barked" the root



FIG. 14 (LEFT). TACHINA-FLY (*PHOROCERA MARGINATA*). $\times 4$.

FIG. 15 (CENTRE). DEAD CUTWORM, SHOWING EXIT HOLE OF PARASITE GRUB. $\times 4$.

FIG. 16 (RIGHT). PUPARIUM OF PARASITE (*PHOROCERA MARGINATA*). $\times 4$.

[Photos by H. Drake.]

just above the soil-surface. It is the spring brood of cutworms that damage the foliage of young turnips, but the "ring-barking" is the work of a second or third generation. The caterpillars transform to pupæ in the ground (Fig. 12), and from these the moths ultimately emerge (Fig. 13).

The depredations of cutworms are difficult to control owing to the prevalence of hedges with their associated growth of coarse grass. If it were practicable to keep the dense growth of grass in such places within bounds there would be a marked improvement, as the cutworms would have to find quarters elsewhere. But autumn cultivation should help to reduce the numbers of moths, since the subterranean pupæ would be destroyed in considerable numbers.

These cutworms are parasitized by the grub of a tachina-fly (*Phorocera marginata*). This is a two-winged insect (Fig. 14) and resembles a bluebottle in general appearance and size, but the body is much more bristly. The egg of this fly is apparently laid on the caterpillar, and the grub on hatching bores into the body of its victim. When the parasite is full-fed it kills the cutworm, cuts its way out of the latter (Fig. 15), and transforms to a blackish barrel-shaped pupa in the ground (Fig. 16). The adult fly emerges by pushing off the end of the pupa-case.

Starlings are great hunters of cutworms, and it is no uncommon sight to see these birds at work fossicking under the soil about the roots of damaged plants, in practically every case a caterpillar being found and destroyed. A notable feature is that the birds almost invariably confine their attention to plants showing signs of cutworm injury.

OTHER CAUSES OF TURNIP-INJURY.

In some cases rabbits will attack young turnip-crops, but their depredations, though certainly sensibly extensive at times in certain localities, are as a whole of minor importance compared with those of the fly.

The diamond-back moth (*Plutella cruciferarum*) and the cabbage-aphis (*Brevicoryne brassicae*) must rank as two of the most serious pests of turnips, rape, and other cruciferous crops. A considerable amount of investigation has been carried out with regard to these insects, and they will form the subject of future work.

It may be mentioned here that the urgent need of investigating the problem of the "turnip-fly" was brought up by farmers at the Ashburton Farm School last year.

CIDER-MAKING.

PRACTICE FOR NEW ZEALAND CONDITIONS.

(Concluded.)

J. C. WOODFIN, Vine and Wine Instructor.

SPECIAL CIDERS AND THEIR MAKING.

Dry Cider.

THE simplest cider to make is that known as dry cider. This is allowed to continue fermenting until the fermentation ceases naturally. The dry or hard ciders are, as a rule, not appreciated by the general public, though preferred in cider-making districts. A little sugar or honey added when partaking of it renders the cider more agreeable to those consumers who do not care for it dry. It is preferable to bottle the cider before it becomes absolutely dry. It is not possible to give a fixed degree at which to bottle, as the degree will vary according to the original sugar content and consequent alcohol produced. Alcohol being lighter than water, more or less of it in proportion to the water content of the cider will affect the hydrometer accordingly.

Sparkling Cider.

Sparkling cider requires either from six weeks at a temperature of 55° F. or two months or more maturing in the bottle at a temperature of 40° F. to develop the effervescence, and it is advisable to leave it at least another month in the cellar to mature. No exact period can be given for the maturing of cider: this varies with its composition and the conditions under which it is fermented and matured. Generally speaking, cider is sufficiently matured for consumption in about twelve months from the time of extracting the juice, though it will improve considerably if kept for a longer period under suitable conditions.

When thoroughly matured the cider should be clear and bright, sparkling in the glass, have a pleasant flavour and bouquet, be

invigorating but not intoxicating in effect, and leave an agreeable after-taste on the palate.

The effervescence produced by secondary fermentation in the bottle will continue for a long time in the glass after the cider is poured out. This, added to its superior flavour and bouquet, distinguishes it from the sparkling cider produced by pasteurization and artificial carbonization. Large quantities of artificially carbonated cider are produced in England and Germany, and the best of it makes an excellent beverage. When made on a large scale it can be produced quicker and at less cost than the sparkling cider in which the effervescence is produced by secondary fermentation.

Champagne Cider.

The production of champagne cider, which when well made is very similar to real champagne, is rather costly, as it necessitates more handling and considerable material. It can be made by exactly the same process as for champagne wine, utilizing matured cider from the previous year and adding a sugared liqueur, clarifying-medium, and wine-yeast. A simpler method is to bottle the cider in the same year as it is made (as in the making of sparkling cider), at 2.5° Baumé, using cider which registered at least 8° B. when in the state of unfermented juice, and containing about 0.3 per cent. of malic acid at the time of bottling.

Temporary corks are placed in bottles and held in place with special clamps. The bottles are then laid on their side in the cellar to develop the necessary gas by secondary fermentation. This usually requires from six weeks to two months. The bottles are then shaken and placed neck downwards in special stands, where they are given a sharp turn every day until all the sediment falls on the cork. The exact moment for placing the bottles on the stand can be judged by an experienced maker from the state of the line of deposit on the bottom side of the bottle. When the sediment is well settled on the cork the bottles are taken from the stand, holding the neck down, the cork smartly withdrawn, and the neck brought quickly into an upright position, the sediment being thrown out by the escaping gas into a barrel prepared for the purpose. Or the sediment is frozen on to the corks by placing the necks of the bottles in a freezing liquid, and the frozen sediment withdrawn with the cork. In both these operations there is a slight loss of cider, which is replaced by a liqueur prepared by mixing some cider with certain proportions of sugar, alcohol, and citric acid. The bottles are then permanently corked and wired.

Light Cider.

Light ciders for home use can be made from the apple-pomace which has already been pressed once, by breaking up the pomace and soaking it with as much warm water as the juice which was extracted. The pomace is placed in a barrel with one end taken out, and the loose end placed on the surface to exclude the air; the pomace is left to soak for about twelve hours, then repressed, and the juice fermented alone or added to the pure juice of the first pressing. The saccharine contents of the second juice will naturally vary with the greater or lesser pressure the pomace was subjected to in the first place.

To facilitate the rapid fermentation of light ciders for home consumption the fermentation vessel can be placed in a warm shed, and $1\frac{1}{2}$ oz. of ammonium phosphate added to each barrel of 42 gallons. The phosphate supplies extra food for the ferments, invigorates them, and assists in their rapid propagation. It is consumed in the process and leaves no disagreeable after-effect. In a couple of months' time, and after racking once or twice, the cider will be ready for consumption. Either pure or diluted juice can be treated in this manner.

In several of the cider-producing countries large quantities of cider are consumed as soon as the first or tumultuous period of the fermentation is over. It has a pleasant, sharp, fruity flavour in this state, contains $1\frac{1}{2}$ to 2 per cent. of alcohol, and makes an excellent beverage in hot weather.

Apple-wine.

In the Nelson District for many years past it has been the custom to make a home-made wine from apple-juice by adding from 2 lb. to 3 lb. of sugar to each gallon of juice. This makes an excellent liqueur wine, and when well made from suitable apples is superior to many of the imported grape-wines.

An exceptionally good type of apple-wine is made by adding $2\frac{1}{2}$ lb. to $3\frac{1}{2}$ lb. of honey to each gallon of apple-juice. The resulting wine after maturing four or five years resembles very closely a high-class sweet sherry. The degrees Baumé of these fortified juices should read from 18 to 20 before fermentation sets in. A cool cellar is not necessary nor advisable for maturing these sweet wines; in fact, they mature better in a warm atmosphere; nor need the air be excluded so rigorously as in making cider; its oxidizing effect assists the maturing process.

BOTTLING.

A little experience under local conditions is necessary to bottle cider successfully, but as a general rule dry cider which will show a slight effervescence when the bottle is opened can be bottled at 1° B., sparkling cider at 1.5° to 2° , and for an extra fizzy or champagne effect at 2° to 3° . It is not advisable to bottle at a higher gravity than 3.5° B. Very few bottles will stand the pressure produced, and through superfluous effervescence much cider will be lost on opening them. When the cider is bottled at 1° B. the bottles can be filled to the cork and laid on their side in the cellar without wiring. For ciders which are liable to be shaken in travelling it is preferable to leave a space of about 2 in. between the cork and the liquid. Ordinary bottles may be used for ciders of a lower gravity than 2° B.; above that it is necessary to use strong beer and champagne bottles. Good wine-corks should be employed—perfect at least at one end—and these should be boiled before using. The writer has found more bottled cider spoilt in New Zealand through defective corks than from any other cause. The corks of all ciders bottled at a higher degree than 1° B. should be securely wired.

Cider should be quite clear for bottling. It will generally clear itself in cold weather, when the ferments are less active. It should be exposed to the effects of the cold as much as possible, and closely watched for the propitious moment. To check fermentation and clear the cider

it is sometimes necessary to rack it into a barrel containing sulphurous fumes produced by burning a piece of sulphur wick or by the addition of sulphurous acid in the form of metabisulphite at the rate of 2 oz. per 100 gallons of cider. If it does not then clear, and the cause is an excess of albuminous matters suspended in the liquid, an addition of tannic acid (1 oz. to a 42-gallon barrel), dissolved first in hot water or cider and then well mixed into the bulk of the cider, can be tried, followed by another racking after a few days into a sulphured barrel, if necessary.

When a filter is available the cider should be bottled straight from the filter. If the cider is bottled in a cloudy condition a greater quantity of sediment will be formed. Cider which continues fermenting in the bottle always forms a small deposit of sediment, and to minimize the effect of this it is advisable to stand the bottles in an upright position the day before they are required for consumption. An excess of gas leaving the cider when the bottle is opened is likely to raise this sediment, and for this reason it is preferable to bottle the cider at 1.5° to 2° B. This should give sufficient effervescence without raising any of the sediment.

PRESERVATION IN BULK.

Cider is undoubtedly best preserved in bottles, and the lighter the cider the greater the risk of keeping it in the wood. However, dry or slightly effervescent ciders (a little life should be kept in the cider if possible) can be kept satisfactorily for some time in barrels that have been varnished or treated with paraffin-wax so as to render them air and gas tight. The cider is filled in up to the bung, which should be tight-fitting and without sacking wrapped round it, and a little melted tallow or paraffin-wax run round it. Bungs 4 in. or 5 in. in length dipped in tallow or wax should be used in the cellar. They are much easier to withdraw from the barrel than shorter bungs.

When a barrel of dry cider is tapped for gradual consumption it is advisable to protect the surface of the cider from the air by covering it with a thin layer of neutral oil; vaseline oil is probably the best procurable for the purpose.

To prevent cider in untreated barrels becoming quite dry, when it is intended to bottle it at a later date, and to assure the generation of sufficient gas to protect the surface of the cider when the barrel is partly empty, an addition of sugar at the rate of 8 oz. per month and per barrel of 42 gallons will suffice to keep up the supply of gas.

In commercial cider-making establishments, where large wooden or glass-lined cement vats are used for maturing and storage purposes, carbon-dioxide gas is introduced through a system of pipes and taps from cylinders charged under pressure with the gas, to fill up the partly empty vats and keep the cider from going sour.

PERRY.

Perry is made from pears in the same manner as cider from apples. It is often employed in the manufacture of imitation champagne. When pears are available they can be mixed in a small proportion with apples for making cider, or a small proportion of apples can be employed

in the manufacture of perry. About 10 per cent. of either would not materially alter the nature of the cider or of the perry. Quinces are also recommended for giving an extra flavour to cider. As the juice is rather difficult to extract, it is advisable to let the quince-pomace macerate after grinding, protected from the air, for twelve to twenty-four hours before pressing; or the quinces can be boiled and then pressed, and the juice added to the apple-juice.

CARE OF CELLAR AND PLANT.

The most scrupulous cleanliness should be exercised in regard to the cellar and plant—everything, in fact, that comes in contact with or near the cider. This is most important. Cider is very subject to deterioration through taking up bad odours and flavours from its surroundings, and extremely susceptible to invasion by vinegar bacteria. The press-house and cellar should be thoroughly white-washed, and the floors concreted—more especially that of the press-house—and well drained. A good water-supply is essential for hosing and scrubbing down the mill and press every day, and for cleaning barrels, washing press-cloths, &c. Press-cloths should be washed daily in water to which a little washing-soda has been added to neutralize the acidity, and then rinsed in pure water.

Barrels and vats should be kept quite dry and sweet when not in use. As the barrels are emptied they should be well rinsed out with clean water and allowed to drain, and, when dry, filled with sulphur-fumes by burning a piece of sulphur wick in them and then bunging them tightly. This treatment, which should be renewed about every three months, will keep the barrels free from mould.

When examining a barrel before use, to ascertain if it is in a suitable condition to store cider in, take out the bung and give the barrel a sharp rap with a stick or piece of wood; then place the nose near the bung and inhale the air from the barrel. If the slightest vinegary, mouldy, or other foreign odour is perceived, pour a solution of hot water and soda (1 lb. to the gallon) into the barrel, bung it down, and roll the barrel about for ten minutes, then rinse with clean water. Now prepare a 10-per-cent. solution of bisulphide of lime and water, pour it into the barrel, and roll the latter again for fifteen minutes. Rinse again, and fill the barrel with clean water, and let it remain therein for a day or two. This treatment will be found efficacious in eradicating slight acetic or mouldy taints. Barrels or vats having more than a very slight acetic taint before treatment should not be used for storing cider.

CONCLUSION.

In conclusion, it will be gathered from the perusal of this brief account that good cider is not difficult to produce, provided that good, sound, ripe apples are used, that the utmost cleanliness is exercised in the process, and that the cider is protected from all unnecessary contact with the air.

Noxious Weeds.—The Bruce County Council has made a special order that Canadian thistle shall be deemed not to be a noxious weed within that county. The Mount Albert Borough has declared fennel a noxious weed.

IRRIGATION AND ITS PRACTICE.

(Continued.)

II. SOME PRINCIPLES AND DEFINITIONS.

R. B. TENNENT, N.D.D., Instructor in Agriculture, Dunedin, and J. R. MARKS, A.M.Inst.C.E., M.N.Z.Soc.C.E., Resident Engineer, Public Works Department, Alexandra.

PHYSICAL NATURE OF THE SOIL.

THE adaptation of a soil to irrigation depends to a large extent upon its physical nature, and it is therefore desirable that the irrigation farmer should have a clear conception of the characteristics of the soil with which he is dealing, for to a large measure his success or failure will be controlled by its texture and formation. No apology is therefore needed in introducing some elementary facts of soil physics, and every intelligent irrigator will appreciate the direct relationship of this science to the practice of irrigation.

In speaking of the soil we refer to the layer of unconsolidated material, derived from rocks by the process of weathering, which covers the land surface of the earth almost everywhere. This material varies in composition according to the rock from which it has been derived, and as the bulk of soil in Central Otago is derived from mica-schist it is classified as a mica-schist soil. The weathering of rocks may be due to two agencies, one being physical and the other chemical. The physical weathering of rock or disintegration may be caused by (1) heat and cold, (2) freezing and thawing, (3) the action of glaciers, (4) erosion of streams, waves, and wind, and (5) the action of plants and animals. Chemical weathering might be looked upon as decomposition whereby the rocks are affected by acids such as carbonic and sulphuric acid, oxidation and deoxidation, the solvent action of weather, &c.

For convenience the soil may be divided into two strata, the top soil and subsoil. The top or surface soil refers usually to that portion cultivated with the plough, and as organic matter and fertilizers are incorporated in this stratum the majority of our crops have their roots there. This stratum of the soil is the more fertile, but is usually deficient in lime, and it is here that the most favourable conditions for bacterial growth and activity are to be found.

The subsoil usually extends to a considerable depth, and is of great importance to the irrigator because drainage, water-movement, root-penetration, and resistance to drought largely depend upon its character. The surface soils of Central Otago do not differ greatly from the subsoil, because the fine particles are not moved downwards by percolating water. Further, certain soluble substances are present which flocculate the colloidal clay and so prevent its deposition. An arid subsoil such as obtains in Central Otago does not possess the raw and unproductive nature common, for example, to the soils of Southland. Hence very deep ploughing may be carried out without detriment immediately preceding the sowing of the crop—in fact, it is of the greatest benefit, because it allows of deeper root-penetration and

greater moisture-retention. In the process of levelling preparatory to irrigating the soil may sometimes be removed to a depth of several feet without injurious effect on the subsequent crop. In humid districts the farmer must be careful not to turn up too much unweathered material just preceding the time of sowing, and if deep ploughing is done sufficient time should be given for the soil to weather before the crop is sown.

Of the many soil-constituents the most valuable is undoubtedly the organic material derived from plants and animals that have lived in and on the soil. This organic matter varies considerably even in the same locality. Table 5 gives a summary of analyses showing the percentage of organic matter present in the soils of Central Otago, North Otago, South Otago, and the Southland Plains respectively.

Table 5.

District.	Number of Analyses.	Percentage of Organic Matter.
Central Otago	29	5.28
North Otago	7	10.39
South Otago	9	7.92
Southland Plains	12	10.89

From this it will be seen that the organic content of the soils of Central Otago is low.

To the irrigator organic matter has a special significance quite apart from its value as a source of plant-food. A soil high in organic matter not only retains a good physical condition, but upon its presence or absence depends to a large extent its water-holding capacity. Thus soils with a high organic content will absorb and retain more moisture than soils with a low organic content. There is no better method of increasing the water-holding capacity of soils than by adding organic matter, and the simplest manner by which this can be done is in growing a crop of clover and ploughing it under. This practice will most assuredly have to be carried out on many farms of Central Otago, as in the majority of cases the soils there show a lack of sufficient humus-forming material. A soil with a few tons per acre of fresh green easily-decaying matter, such as lupins or clover, ploughed into it will act like a sponge, and when mixed with the mineral portion of the soil will give higher porosity and greater moisture-holding capacity. Its presence retards capillary movement in the soil and induces a better mulch, thus helping to retain moisture by reducing evaporation. When organic matter is added to sand its capacity for holding moisture is considerably increased, as Table 6 exemplifies.

Table 6.—Effect of Organic Matter on the Retention of Moisture in Sand.

Soil Material.	Grams of Water retained.	Percentage of Increase.
Coarse sand	13.3	..
Coarse sand with 5 per cent. of peat ..	18.6	40.0
Coarse sand with 10 per cent. of peat ..	24.7	85.7
Coarse sand with 20 per cent. of peat ..	40.0	200.7
Peat	184.0	1283.4

The Central Otago settler, therefore, realizing the need for building up his soil in organic matter, should certainly make a practice of growing special crops for such a purpose, and there is no doubt that the extra cost of labour which this practice involves will be amply repaid by increased returns.

WATER AND THE SOIL.

Soil-water: When it is remembered that plant-growth cannot take place without water, and that plants in themselves consist of from 60 to 90 per cent. of water, it will be realized that the importance of soil-water warrants a brief discussion. The large percentage of water contained in plants by no means represents the amount required by them in the process of growth from the seedling stage until maturity is reached, for a continuous stream is passing in through the roots, and is finally transpired through the minute openings or stomata of the leaves. As the amount of water required to produce 1 lb. of dry matter is from 300 lb. to 800 lb. the soil must contain a sufficient amount of moisture, and must also be in such a physical condition that this supply can readily be delivered to the plants. If a sufficiency of water is not forthcoming the plant will gradually wilt and die before full maturity has been reached.

Water exists in the soil in three conditions—hygroscopic, capillary, and gravitational. The water under each of these conditions is of the same chemical composition, differing only in the force holding or moving it.

Hygroscopic moisture: At ordinary temperatures a very thin film of moisture adheres to the soil-particles, and this moisture cannot be driven off unless by the application of great heat. This is called "hygroscopic moisture" and cannot be used by the plant. From twenty-nine analyses made of the soils of Central Otago the hygroscopic moisture was estimated as being 3.21 per cent. As the plant is unable to make use of this moisture it might be thought that its wilting-point would be reached when the water content was 3.21 per cent., but such is not the case. Determinations have been made of the wilting-point of plants in soils with the above-mentioned percentage of hygroscopic moisture, and it appears that this point is reached in such soils when the moisture content is in the vicinity of 4.5 per cent.

Capillary water: When water is applied to the ground, either in the form of rain or by irrigation, a portion runs off the surface, leaving the remainder to soak into the soil. A certain proportion of this water, in the course of its passage through the earth, is retained on the surface of the soil-particles and in the interstices, and does not drain away. This is termed "film" or "capillary" water. Capillary water is the form used by plants, but even under the driest conditions they are unable to use the total amount of film-water present in the soil. This water does not soak away into the lower levels of the soil, but is capable of moving sideways and upwards to the surface by capillary attraction; creeping from film to film and through the minute spaces occurring in the soil until it finally reaches the surface. There it is evaporated by the sun and wind, the water from the lower strata coming up to take its place.

To prevent loss of this water should be the aim of every irrigator, and the manner in which this is most easily accomplished is by periodically stirring the surface of the soil with cultivators and so forming a soil-mulch. By stirring up the surface after each irrigation and after each fall of rain capillary movement to the surface is retarded and little loss of moisture occurs through evaporation. Some soils such as sand, peat, &c., are self-mulching, but this is not the case with the soils of Central Otago. There the soil, after irrigation, settles into a hard cement-like form, readily cracking (Fig. 12), and in this condition evaporation takes place very rapidly. With such conditions obtaining it is of prime importance that soil-mulches

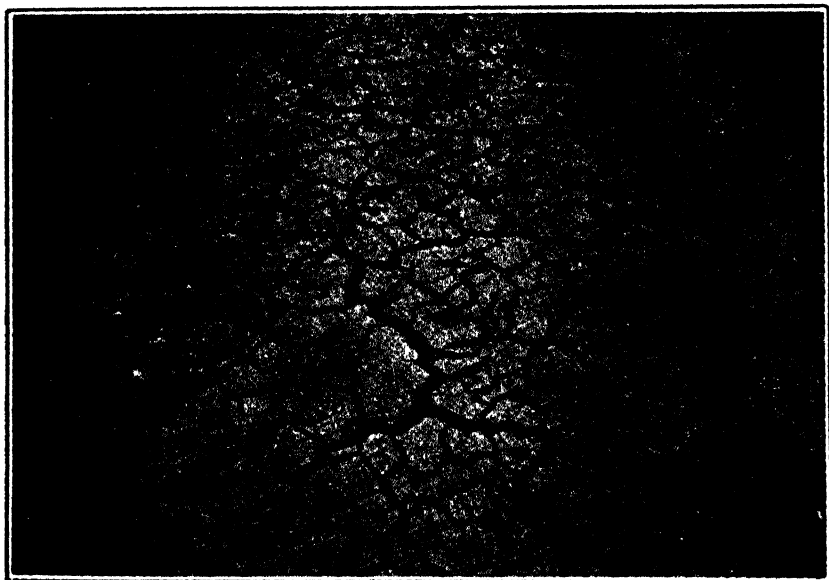


FIG. 12. LAND IN BAD PHYSICAL STATE AS RESULT OF DRY CONDITIONS.

The soil is cracked to some depth, and the moisture is fast leaving the ground.

[After Van Styke.

should be formed when occasion demands it, and the successful irrigator desiring to make the most economic use of his water, and incidentally with a view to lessening the number of irrigations required, will assuredly make a practice of cultivating his land, whenever practicable, after every application of water or fall of rain.

This is a feature of irrigation which every settler should be acquainted with. The loss of moisture by evaporation following an irrigation is very great, particularly when the crop is in its early stages with little or no growth to shade the ground. At Galloway Experimental Area it was found that where the ground had not received cultivation till eight days after irrigation the water lost by evaporation was in the vicinity of 2 in., or 227 tons per acre. On adjacent

ground where surface-cultivation had been carried out after irrigation the loss amounted in eight days to $\frac{1}{2}$ in., or approximately 57 tons per acre, being a reduction of 75 per cent. Fig. 13 (adapted from Fortier) shows how effectively cultivation after irrigation retains moisture in the soil. In this case, had the cultivation begun as early as the second day instead of the fifth day after irrigation the loss of moisture would have been materially less than is shown. This is a typical instance of the value of cultivation after irrigation, and the necessity for carrying out this practice whenever possible cannot be overstressed.

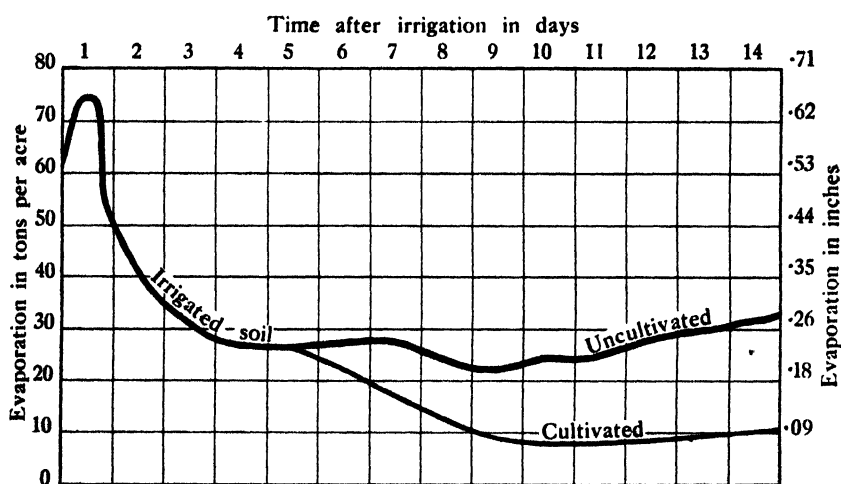


FIG. 13. GRAPH SHOWING SAVING OF WATER RESULTING FROM EARTH MULCH FORMED BY CULTIVATION.

Gravitational water: Gravitational or free moisture saturates the soil, filling the spaces existing between the soil-particles. It moves downwards into the subsoil under the influence of gravity until it reaches a fixed level where the pore-spaces are already full of water. The level varies considerably in different locations; in some it may be many feet, in others within a few inches of the surface, while in some cases it is at the surface. This level of free water is termed the "water-table." The water-table is the level at which water stands in wells. This water can be utilized by the plant when it is below the layer of root-growth but sufficiently near to the surface to be drawn up by capillary attraction to the upper layers of the soil. When so near the surface as to saturate any portion of the soil penetrated by roots of crops it may be regarded as unavailable, injuriously affecting growth in most crops in that it shuts off the needed supply of air, making the soil cold, and thus preventing the formation of nitrate nitrogen. Further, its presence promotes the formation of compounds poisonous to plants, retards the decomposition of organic matter, and produces other conditions unfavourable to crop-growth.

In Central Otago, generally speaking, the porous nature of the subsoil does not permit of the water-table rising to a height where damage is likely to result. But, of course, there are certain localities in that district, notably portions of Ida Valley, where excessive irrigation on the slopes flanking the valley result in raising the water-table to such a height that swampy conditions result to the serious detriment of the crops growing thereon (Fig. 14). Such undesirable conditions can only be prevented from arising by a more sparing use of water in small quantities at frequent intervals, and the water-table must be lowered by a proper and adequate system of drainage.

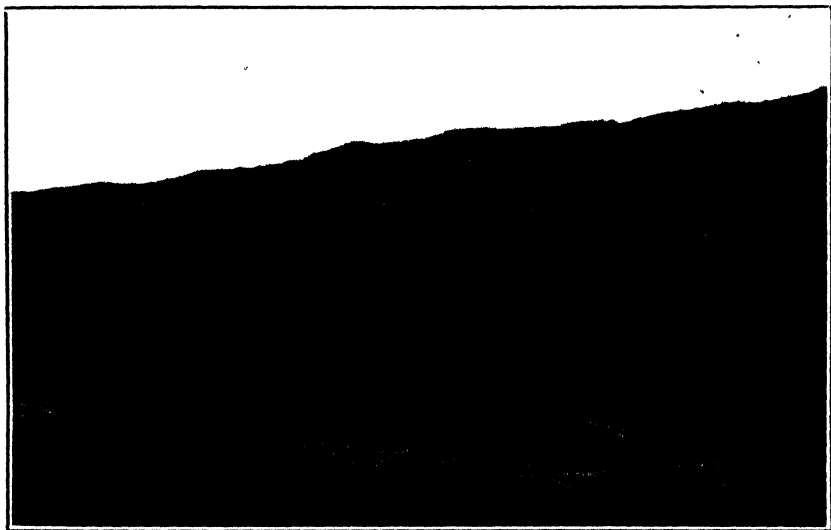


FIG. 14. RUSHES APPEARING IN IDA VALLEY AS A RESULT OF OVERIRRIGATION.

ALKALI.

In semi-arid regions many soluble substances are formed by the decomposition of rocks, and these, generally speaking, would be washed out of the soil to a large extent if the rainfall were sufficient. As it is they accumulate in arid soils and are sometimes brought to the surface, where they are deposited in such accumulations as to seriously inhibit the growth of normal plant-life. These injurious salts are chiefly the chlorides, carbonates, and sulphates of sodium, or may on occasion prove to be the chlorides or sulphates of magnesium or potassium and other salts.

While not wishing to alarm settlers in Central Otago of the future probability of these alkalis accumulating on their farms, and so rendering the soil thereon unproductive, it must be stressed that the effect of using too much water has a decided tendency to accelerate an increase in the deposition of these salts. It can readily be understood that when large quantities of water are applied to the ground a considerable proportion of these salts are turned into solution. Excessive evaporation follows excessive watering, and the dissolved

salts are by capillarity brought to the surface of the soil, where they are deposited. In Ida Valley the writers have observed small patches of white alkali which no doubt are the direct result of overirrigation and insufficient drainage.

In certain other countries the accumulation of alkali has caused a considerable amount of anxiety, and every precaution is being taken to prevent its occurrence. It is quite probable that the decay of ancient civilizations which depended primarily upon irrigation for their existence was to no inconsiderable degree due to the slow accumulation of alkali on their agricultural lands. A rational use of water is therefore necessary, and a realization that the practice of drainage goes hand in hand with irrigation is essential. With our present knowledge of soil physics and agricultural science there is no need for a recurrence of the destruction of soil fertility by irrigation as in ancient times, provided that this science is properly applied.

DUTY OF WATER IN IRRIGATION.

Various writers have different ways of defining the term "duty of water," but for general purposes we prefer to look upon "duty of water" as being the total amount of irrigation water which must be applied to the land during the whole irrigation period in order to bring any crops growing thereon to full maturity. Duty of water in irrigation, therefore, expresses the relation between a given quantity of water and the area which it serves. The duty of water is said to be a high or a low one according as a given quantity successfully irrigates a large or a small area. From an irrigation point of view there is no problem of such great importance as that dealing with the volume of water required in the production of payable crops, when such water is applied in the most advantageous and economical method. Naturally this aspect of the question is extremely complex, and there are in New Zealand no definite data upon which to dogmatize, this branch with us being merely in its initial stages of investigation. In due course it is hoped to work out definite data in regard to the water-requirements of the various crops on the Galloway Experimental Area, which has been established for such purposes, but for the present use must be made of information obtainable from other sources.

The greatest service is rendered by a given quantity of water when applied to the soil, either in the form of rain or by irrigation, where every drop of such water is absorbed by the roots of the plants growing on the ground, thus leaving none to be lost by percolation or by evaporation from the surface. If it were practicable to ensure that all the water contained in the soil was lost therefrom only by transpiration through the stomata of the leaves of the crop growing upon that soil, then a very limited rainfall and a small irrigation would suffice. From this it will be appreciated that the duty of water in crop-production is based on the necessary losses of moisture in the soil, whether by transpiration through the leaves and stems of the plants, by capillarity and consequent evaporation, or by surface and under drainage. The aim of every irrigator, therefore, must be the limiting of water losses from such sources as just enumerated, and the more successful he is in this respect then to an equal degree will the duty of water be improved.

In Central Otago, where irrigation is necessary to bring crops to full maturity, the loss of water by drainage and surface evaporation can be reduced to a minimum by a rational method of water application at suitable intervals, and by proper cultivation to conserve moisture in the soil, the chief loss which occurs being that which is transpired through the plant itself. King, in his work "Irrigation and Drainage," gives data of the minimum number of acre-inches of water which may be made to produce yields of different amounts of various crops under conditions where no drainage occurs, and where surface evaporation is reduced to the absolute minimum. The results are given in the following table:—

Table 7.—Highest Probable Duty of Water for Different Yields per Acre for Various Crops.

Yield per Acre in Bushels.	Least Number of Acre-inches of Water.				
	Wheat.	Barley.	Oats.	Maize.	Potatoes.
15	4.5	3.21	2.35	2.52	..
20	6.0	4.28	3.13	3.36	..
30	9.0	6.42	4.70	5.04	0.82
40	12.0	8.56	6.27	6.72	1.10
50	15.0	10.70	7.84	8.40	1.37
60	18.0	12.84	9.40	10.08	1.65
70 .. ..	..	14.98	10.98	11.75	1.92
80 .. ..	..	..	12.54	13.43	2.20
100 .. ..	..	..	15.68	16.77	2.75
200 .. ..	..	..	..	..	5.49
300 .. ..	..	..	..	..	8.24
400 .. ..	..	..	..	..	10.99
Tons per acre ..	1	2	3	4	6
Clover hay* ..	4.43	8.85	13.38	17.70	26.55
Tons per acre ..	10	12	14	16	18
Maize with ears†	20.72	24.95	29.10	33.26	37.42
Maize silage ..	7.17	8.61	10.04	11.48	12.91

* 15 per cent. water.

† 70 per cent. water.

This table, then, may be regarded as illustrating the minimum quantity of water which will bring the crops mentioned to full maturity, so as to produce the yields specified under conditions where losses by evaporation and drainage have been practically eliminated. In addition, it must be borne in mind that the soil at the time of seeding would possess the requisite amount of water for suitable germination-conditions, and that sufficient moisture would be retained therein at the expiry of the growing-period to prevent checking the vigorous growth of the plant. The table therefore serves to illustrate the minimum quantity of water necessary for the yields given; the total loss which occurs in bringing the water to the field, either by soakage or by evaporation from the various ditches, by wrong methods of applying the water to the land, or by improper methods of cultivation after irrigation, must certainly be added to the quantities given.

From a hundred cases taken from all parts of the world King deduces during an irrigation season a mean value of 20.24 in. for the duty of water. This figure is based on actual practice and not deduced from experimental data.

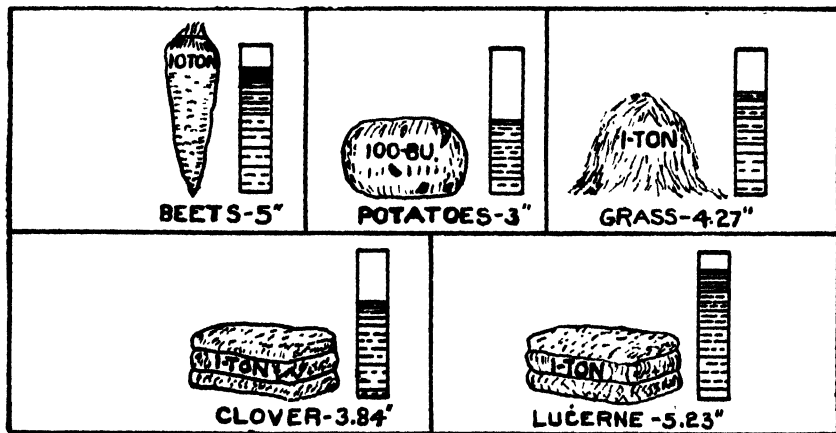


FIG. 15. DIAGRAM SHOWING WATER REQUIREMENT OF VARIOUS CROPS PER ACRE.
(Original.)

AMOUNT OF WATER PROVIDED BY GOVERNMENT SCHEMES IN CENTRAL OTAGO.

Up to the time of writing the amount of water provided for each acre of land under the Government irrigation agreements is $\frac{1}{150}$ of a cusec flowing continuously day and night for 150 days, or its equivalent in larger quantities taken in flushes at intervals. This is equivalent to 23.76 acre-inches per season, and when it is remembered that the average rainfall is 15.18 in., two-thirds of which is available for plant-production, the allowance would appear to be a fairly liberal one, the two combined providing a total of 33.88 in. The case of Ida Valley, however, is an exception, for there the elevation of the country is higher, the irrigation season shorter, and the temperatures are not so high as experienced in the other irrigation areas, therefore the evaporation from the soil being less. The water allowed for Ida Valley is $\frac{1}{100}$ of a cusec, instead of $\frac{1}{150}$, this being equivalent to 17.82 in.

WATER RENTALS.

So far the principle adopted in regard to water rentals has been based upon providing a reasonable rate of interest and sinking fund on the capital cost of constructing the scheme. In the case of the Ida Valley scheme the charge for water is 10s. per acre per annum, but with the more recent schemes—namely, Manuherikia, Galloway, and Olgre Terrace—the charge is 16s. per acre. In the case of the Ardour scheme the charge is 15s. per acre. These water charges, when compared with those obtaining in other countries, must be regarded as quite reasonable. For instance, the average water charges in the Yakima Valley,

State of Washington, U.S.A., work out at 15s. 3d. per acre per annum, while as high as 24s. per acre is charged in that valley. In Southern California the water charges are generally higher, in some cases the rate of 72s. per acre-foot being charged, which would represent for a supply equivalent to that provided by the New Zealand Government a charge of 144s. per acre per annum. In Central Otago a sliding scale of water charges has been adopted to facilitate the settler in becoming properly established before the full charge comes into operation. The scale is based on a charge of 1s. per acre for the first year, and gradually increases through a period of five years to the maximum charge per acre as outlined above.

FREQUENCY OF IRRIGATIONS AND THE WATER-HOLDING CAPACITY OF SOILS.

Under the heading of "duty of water" an indication has been given of the total quantity of water required during the irrigation season for the production of crops upon the land, but in order that the quantities there referred to may be used with greatest effect it is now desirable to consider the number of irrigations into which such volumes of water may be divided. At the outset it must be recognized that in the absence of definite data pertaining to Central Otago the problem presents great difficulties, and consequently we are forced to generalize on this subject.

It is, of course, recognized that various types of soils have varying water-holding capacities; for example, a heavy clay soil will hold and retain much more moisture than one that is light and loose, and this fact is of the utmost importance to the irrigator (Fig. 16). Bearing in mind the fact that the majority of the soils utilized for irrigation in Central Otago are of a fairly light, free, open nature, it will naturally be appreciated that such soils have a limited water-holding capacity—much less than the heavy soils of, say, Southland. Consequently, once the maximum amount of water has been applied in order to saturate those light soils to their full holding-capacity, then the application of any further quantities of water must result in the loss of such water by percolation, thus reducing the effective work which that water might reasonably be expected to perform. In other words, the duty of water will be fairly uniform over all the soils of Central Otago, provided a systematic study is made by the farmer of the extent to which he can best saturate his soil in any one watering, but if over saturation is carried out then the duty of water will be considerably lowered.

To come to a concrete example, there are many farmers whose soil has a water-holding capacity of 3 in. of water, but instead of dividing their yearly 24 in. supply of water into eight irrigations of 3 in. each they probably endeavour to do the work with four irrigations of 6 in. at each irrigation, and consequently find that the water-supply is insufficient for maximum crop-production. Actually the trouble is that in each irrigation the soil has been well oversaturated by at least 3 in. of water, which is lost by percolation.

Certain conditions determine the various amounts of water which should be applied at one time to the soil. These are (1) the water-holding capacity of the soil and subsoil, (2) the depth to which the roots of the crop penetrate the soil stratum, (3) the rate at which the soil

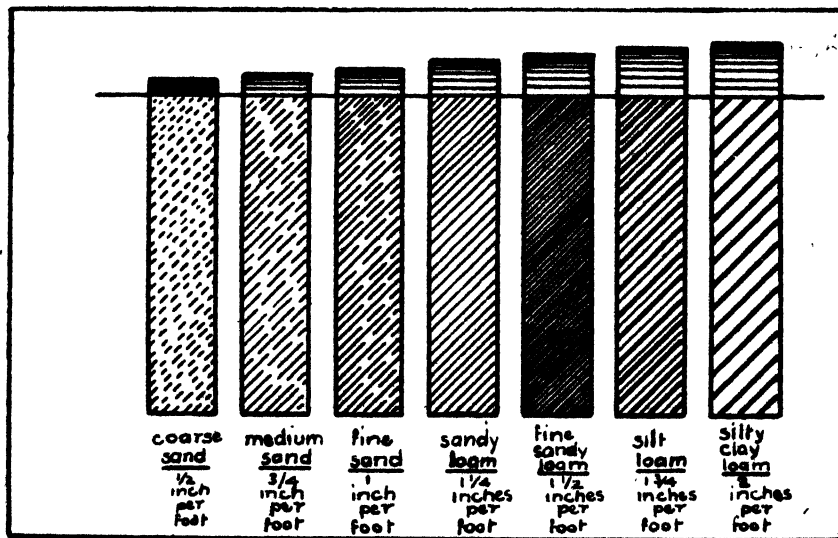


FIG. 16. DIAGRAM ILLUSTRATING USABLE WATER CAPACITY OF DIFFERENT TYPES OF SOIL.

[Original.]

below the root zone may return water into it by capillary attraction, and (4) the degree to which the soil in the vicinity of the roots has lost its moisture.

So far as we are concerned we need only consider here the water required for plant-growth. Briefly stated, under conditions where the soil is not too dry for good growth, and where the object is to saturate the soil without causing any loss by percolation below 4 ft. to 5 ft., the amount of water required for each irrigation should range between 2.5 in. for those soils with a loose open texture and coarse grain and 4.5 in. for those having a loamy texture.

Where the moisture content of a soil is low, due to excessive drying having taken place, the amount to be applied will vary from 4 in. in the case of coarse soils to as high as 11 in. on fine soils with a high water-holding capacity. From an economic point of view, the fewer number of irrigations given to the crop the cheaper will be the cost of production, and, further, less water will be lost by surface evaporation from the ditches and from the field. For practical purposes, however, the aim of the irrigator must be to apply as much water to the crop as the soil will hold in the vicinity of the root zone, and to conserve that water by proper means of surface cultivation.

Assuming that a crop of maize may be grown in 110 days and that 12 in. of water in addition to rain is essential to bring the crop to full maturity, then, if the water-holding capacity of the soil in the vicinity of the roots is from 2 to 4 acre-inches, with proper management it should be possible on open soils to produce the crop with six irrigations, and on the more retentive soils with three irrigations, thus making an interval of from eighteen to thirty-seven days between each irrigation.

From this it will be seen that in determining the number of irrigations which a crop requires certain factors must be taken into consideration by the farmer, and it is just here that the intelligent and observant



FIG. 17. MEASURING-WEIR IN A CENTRAL OTAGO WATER-RACE.



FIG. 18. WATER-METER AS USED IN AUSTRALIA.

[After Fortier.

irrigator will obtain the most consistent and successful results. He must first determine by observation and actual trial the amount of water which his soil can retain to a depth of about 3 ft. to 4 ft., and, having applied water to do this thoroughly, the crop can then be allowed to draw upon that moisture which is held in the soil until such a time as a deficiency of soil-moisture occurs. The period of time which will elapse between the initial stage, when the soil is fully saturated, and that when a supply is just barely sufficient to sustain the growing crop will depend on several factors, such, for example, as the class of crop, type of cultivation, and temperature; but when a deficiency of moisture occurs this fact will at once become apparent by the crop wilting. The practical irrigator, however, will never allow this wilting-point to be reached, for by examination of the soil and from previous experience he should be in a position to determine the length of time which should exist between each irrigation, and before any check in the growth of the plant takes place a second irrigation will be given.

To the practical farmer the question will immediately arise as to how the above-stated ideal may be put into practice, for having to a certain degree ascertained the water-holding capacity of his soil and the number of irrigations desirable with due regard to economy, he is at once confronted with the problem of how to irrigate his crop—say, six times in the season with 3 acre-inches of water on each occasion. To the average settler this difficulty might appear to be insurmountable when one bears in mind the common method of irrigation in Central Otago, but in the matter which now follows the writers hope to show how definite quantities of water may be rapidly and thoroughly applied to crops with due regard to the necessity of economy in all the methods advocated.

MEASUREMENT OF WATER.

It is advisable that every irrigator should appreciate the terms of measurement generally employed when computing the amount of water applied to the land. In different parts of the world various units of measurement are in vogue, but those most generally used by irrigators are the terms "cubic foot per second," "acre-foot," and "acre-inch."

Cubic foot per second: This term, usually abbreviated to "second-foot" or "cusec," represents a flow of 1 cubic foot of water per second. The term "cusec of water" is therefore in New Zealand synonymous with the miner's term "head of water," and though this latter term is in legal use in the Dominion it is at best somewhat unsatisfactory, for in the science of hydraulics the term "head" usually indicates pressure. The measurement of water is effected in several ways, such as measuring the flow over weirs or through gauge-boxes (Figs. 17 and 18).

Acre-foot: As the term indicates, an acre-foot is the volume which will cover 1 acre to a depth of 1 ft. The relation between the two measurements may be convenient in that 1 cusec flowing for twenty-four hours would cover an acre nearly 2 ft. (1.98) in depth, or one cusec for twelve hours is equivalent to 1 acre-foot.

Acre-inch: An acre-inch is one-twelfth of an acre-foot.

Where the flow of water is known in cusecs Table 8 will be of use in converting the discharge from cubic feet per second (cusecs) into acre-feet.

Table 8

Discharge, in Cusecs.	Volume in Acre-feet if the Discharge in Cusecs (Column 1) flows for				
	1 Hour.	12 Hours.	1 Day (24 hours).	1 Week.	1 Month (30 days).
	Acre-feet.	Acre-feet.	Acre-feet.	Acre-feet.	Acre-feet.
0.25	0.02	0.24	0.49	3.47	14.88
0.50	0.04	0.49	0.99	6.94	29.75
0.75	0.06	0.74	1.48	10.42	44.63
1	0.08	0.99	1.98	13.88	59.50
2	0.17	1.98	3.96	27.76	119.00
3	0.25	2.97	5.95	41.65	178.50
4	0.33	3.97	7.93	55.53	238.00
5	0.41	4.96	9.92	69.42	297.50
6	0.49	5.95	11.90	83.30	357.00
7	0.58	6.94	13.88	97.19	416.50
8	0.66	7.93	15.87	111.10	476.00
9	0.74	8.92	17.85	124.90	535.50
10	0.83	9.92	19.83	138.80	595.00

(To be continued)

SPONTANEOUS COMBUSTION OF HAY.

AN EXPERIENCE AT MOUMAHAKI EXPERIMENTAL FARM.

J. W. DEEM, Instructor in Agriculture.

THERE is no doubt that many haystacks which are built a little on the damp side heat up and burn spontaneously. In this connection a recent experience at the Moumahaki Experimental Farm is of interest. A field of mixed clover and rye-grass was cut on 1st December last and stacked on the 5th. The day of stacking was rather dull, and the material in parts did not feel quite in condition, but as the area was only sufficient to provide a small stack it was thought safe to proceed.

The stack was kept under observation, and in about three weeks after cutting it was noticed that one end was sinking badly and that the stack was smelling and fairly warm. The condition was noted from time to time, and on 14th January, just forty days after stacking, the heat was so great that the stack was expected to go on fire at any time. A water-supply in barrels was got on hand, and a start made to cut a shaft into the stack where it appeared hottest. After the removal of a couple of feet of part hay and part ensilage charred material was reached, which burst into flames immediately it came into contact with the air, and water had to be frequently used to control the fire. This charred material, after being dampened, was loaded into a dray and carted out into a grass-paddock and dumped. The stack was then watched for several hours for fear that any lumps of the charred stuff might have been dropped among the good material and later start a fire, but so far as the stack was concerned nothing further happened.

The necessity for care, however, was forcibly brought under notice. The charred material which had been dumped—each load being put down in a separate heap in the paddock—frequently broke into flames during the first hour or two after being carted out. These fires were put out by water and further spreading of the material, the last signs of fire being noticeable about 10 p.m. on the same day. On the afternoon of the next day it blew very hard, and one of the dumped loads burst into flames and burnt to a cinder, showing that a small lump of the material had retained its heat for fully eighteen hours, going on fire only when the wind was hard enough to dry it out.

When the charred material had been removed from the stack a hole was left approximately 10 ft. long, 8 ft. deep, and 3 ft. wide, the actual seam of burning material being 10 ft. by 3 ft. by 2 ft. One end of this seam had reached within 1 ft. of the outside wall of the stack, and had it been left another day or so it must have broken through and destroyed the whole stack. Surrounding the charred material there was a quantity of ensilage, but there was evidence that this was being gradually dried and burnt. The ensilage portion of the stack was fed out to the dairy herd and eaten with relish by the cows.

Extensive experiments on spontaneous combustion of hay have been recently carried out by Messrs. J. S. Haldane and R. H. Mackgill, of the Cherwall Laboratory, Oxford. The following extract from a valuable paper by them, published in *Fuel in Science and Practice*, discusses the results of the investigation:—

Although the spontaneous firing of a haystack is, like that of a mass of broken coal or other easily oxidizable material exposed to the action of oxygen, due to an oxidation process, the process in the case of hay has peculiar features owing to the initial co-operation of living organisms in the oxidation process. The experiments have shown, however, that there is no essential difference between the process in the haystack and in a mass of coal. The rapid development of heat in a large mass of damp hay is due almost entirely to the growth and activity of bacteria, of which one species raises the temperature to about 42° C., while another species, which then begins to grow, can take the temperature to near 70° C. Oxidation, however, occurs in the damp hay at ordinary temperatures at a limited rate even when bacterial action is absent; and a perfectly sterile haystack would be capable of spontaneous firing if it were large enough and were given sufficient time, just as any sufficiently large mass of broken coal is capable of spontaneous firing.

The fact that haystacks do not spontaneously fire more frequently is in the long-run due to their being of only moderate size. With stacks below a certain size the hay can never fire, since even if there is considerable heating from bacterial activity the heat produced by purely chemical activity at the temperature to which the bacteria have been able to raise the hay is too small to balance the loss of heat from the surface.

The connection between the amount of moisture present in hay and the rate of oxidation or heat-production, whether bacterial or purely chemical, comes out quite clearly in the experiments. It seems that when hay is stacked it should contain sufficient moisture just to secure the advantages arising from bacterial fermentation, while bringing the bacterial activity to an end as soon as a comparatively small amount of water has evaporated from the warm stack. The stack should also not be so large or high that the heat produced by purely chemical oxidation at the maximum temperature produced by the bacterial action cannot readily escape to the surface. Under these conditions the stack heats to about 60° C. and then cools down owing to cessation of bacterial activity. If, however, the stack has so great a diameter and height that the comparatively small amount of heat produced by chemical oxidation cannot escape as quickly as it is liberated, the stack will go on rising in temperature till firing or smouldering occurs. With a large stack the temperature must either go on

rising or go on falling. There is no half-way course, since the rate of chemical oxidation at a constant temperature becomes less and less with lapse of time. It is evident, also, that hay that has been put into small stacks in a rather damp state, and then allowed to warm up and partially dry, will be much less apt to heat dangerously in a large stack. In this respect hay resembles coal.

At a low temperature the rate of oxidation in damp hay is much greater than in freshly powdered coal at the same temperature. Thus 100 grm. of damp hay at 40° C. absorbed 278 c.c. of oxygen per hour as compared with an initial oxidation of 43 c.c. of oxygen per hour for 100 grm. of the readily oxidizable Barnsley seam hard coal. Moreover, in the case of hay the heat produced per cubic centimetre of oxygen absorbed is presumably about double that produced in the oxidation of coal. It is thus easy to see why damp hay heats to a certain moderate temperature so much more readily than coal. When, however, the temperature rises to the point when bacteria can no longer live, the purely chemical oxidation which still persists in the hay is comparatively small, so that further heating, if it occurs at all, is very slow. This further heating can, however, only occur in very large stacks. Thus it comes about that while steaming or "sweating" of coal is a certain sign of imminent danger of firing, the steaming of a haystack is usually nothing but a sign that an advantageous amount of fermentation is occurring, and if the temperature in any part of the stack does not exceed about 70° C. (or 160° F.) firing of the stack need not be feared.

In the foregoing discussion the experimenters state that hay-stacks below a certain size can never fire. The size would appear to depend greatly on the situation. A certain-sized stack might be quite safe if built out in the open, where it is exposed to the sun and wind. On the other hand, the same stack built under the lee of a plantation or other shelter might fire. As already mentioned, the stack which fired at Moumahaki was a comparatively small one—14 ft. by 26 ft.—but was built on the sheltered side of a plantation, which helped it to retain the heat. There is no doubt that where the material is not quite right it would be safer to stack it in the open, or put the hay in cocks until the main heating is over. Unquestionably the latter system makes the better hay.

Dairy Records.—This subject came before the International Congress of Agriculture, held at Paris last year. The Congress considered that there should be a world standard method of indicating pedigrees and records of purebred stock, and also a standard method for the issue of certificates of origin and health in the case of all such stock.

Agricultural Education.—This subject was discussed at the last meeting of the Board of Agriculture, and regret expressed that so few high schools made provision in their syllabus for a systematic course in agriculture. It was again pointed out that students with a bent towards agriculture and who would be likely to take up the study of agricultural science were placed at a decided disadvantage by the present matriculation syllabus, which had the effect, in practice, of discouraging agriculture at the expense of the study of a foreign language. The measure of advantage gained by a knowledge of foreign languages was fully realized, but the Board was of opinion that the syllabus should be so rearranged as not to cause this to act as a deterrent to students taking up agriculture as a subject. The Board had previously made representations on this point to the University Senate without satisfactory results, but decided to again take the matter up with a view, if possible, of inducing the Senate to reconsider its former decision.

LOSS IN WEIGHT OF STORED APPLES.

R. WATERS, Plant Pathologist, Biological Laboratory, Wellington.

THE further investigation into the cause of apple flesh-collapse this year includes a study of the temperature-humidity ratio—a line of procedure clearly indicated by the work of the past three years. Long running-hours, a low flesh-temperature range, high relative humidity, and unwilted apples seemed to be associated with flesh-collapse in cool store; shorter hours, higher temperatures, lower humidity, and consequent wilted condition appeared to result in greater freedom from the disease. The following questions therefore presented themselves:—

(1.) Was the freedom from flesh-collapse in farm-sheds and other unrefrigerated apple-stores due to the greater drying-power of the surrounding atmosphere?

(2.) Conversely, was the abundant development of the disease among certain varieties in cool store due to the low flesh-temperature range, the high humidity, and feeble drying-power which are often in evidence where the trouble is pronounced?

(3.) Would the alteration of the temperature-humidity ratio of such cool stores to produce a greater drying-power reduce the proportion of flesh-collapse?

(4.) Would the loss in weight of the fruit be a useful measure of the effects of different temperature-humidity ratios, and would such loss be measurable in the first ten weeks of cool storage when flesh-collapse has been shown to be initiated?

Experiments to answer these and other questions were then devised and are now in progress, and it has been suggested that last month's results from the preliminary loss-in-weight experiments should be set out for the information of those who are confronted with the problem of the satisfactory cool storage of apples this season.

RESULTS OF THE PRELIMINARY EXPERIMENTS.

The experiments were made, in two different cool stores concurrently, with several cases each containing exactly 30 lb. of Sturmer apples picked from two different orchards on 2nd and 5th March respectively, and placed in their storage positions within twenty-four hours of picking. After standing for a certain time the fruit was examined for wilt and the loss in weight ascertained. For convenience the results are here expressed on the basis of one bushel case of 40 lb., as follows:—

Storage at a low temperature: 40 lb. of Sturmers in cool storage, with discharge temperatures varying between 31° and 40° F. and relative humidity varying between 66 and 84 hygrometric degrees, lost—(1) at the first store, 9 oz. in eleven days and 13 oz. in twenty days; (2) at the second store, 8 oz. in twelve days and 11·7 oz. in twenty days.

Storage at slightly higher temperature: 40 lb. of Sturmers in cool storage, with discharge temperatures varying between 33° and 42° F. and with relative humidity varying between 70 and 80 degrees, lost—

at the first store, 7.7 oz. in eleven days and 13.7 oz. in twenty days; at the second store, 8.7 oz. in twelve days and 13.3 oz. in twenty days.

Storage at much higher temperature: 40 lb. of Sturmers stored in a packing-room, exposed to the much higher natural temperatures and the natural humidity fluctuations, lost—at the first store, 18.7 oz. in eleven days and 32 oz. in twenty days; at the second store, 16 oz. in twelve days and 27 oz. in twenty days.

Suggestions.

These figures suggest:

(1.) That the study of the loss in weight of stored apples offers great possibilities of affording information of considerable value in cool storage.

(2.) That in the first few weeks it is possible to measure progressively the total drying-effect of a cool store by weekly determinations of the loss in weight of a definite quantity of fruit.

(3.) That it is possible to arrive beforehand at the total loss in weight necessary to produce wilting, so that the liability thereafter of damaging fruit in store by excessive drying may be avoided.

(4.) That under the conditions of this experiment a 40 lb. case of Sturmers could lose 2 lb. of water without being detrimentally affected by shrivelling.

(5.) That certain cool stores, even with a dripping-brine system, do not extract anything like this amount in the first few weeks of storage.

(6.) That the advantage claimed from delaying the cool storage of certain varieties after picking may possibly be due to the far greater loss in weight under outside conditions as compared with that in the cool stores.

(7.) That to remedy this apparent defect in cool store it may be necessary to modify the temperature-humidity ratio so as to increase the drying-power of the atmosphere in the first few weeks of cool storage.

(8.) That the difficulty of effecting a requisite loss in weight may be more pronounced in a wet season, when the incoming fruit is surcharged with moisture and when the packing and cases may be damp or wet; or again later in the season, when the stores are carrying the maximum load of fruit.

(9.) That the relative drying-effects of different cool stores with different running-hours, temperature-ranges, and humidity-conditions—in fact, with different systems and management generally—might be indicated cumulatively and measured and compared periodically by determining the loss in weight of a given quantity of fruit.

(10.) That in a five-thousand-case chamber the extraction of even $\frac{1}{2}$ lb. of water per case in eleven days requires that 2,500 lb. (equal to 250 gallons) of water shall be removed in that time—a fact that demands in a wet system constant reconcentration of the dripping brine, or, in a dry system, much more frequent defrosting of battery-pipes than has hitherto been deemed necessary, and even longer (and intermittent) hours of running in the early part of the storage season.

NOTE.—The foregoing experiments, which were made with immature fruit at a time when the stores were carrying only small quantities of other fruit, are being repeated on a larger scale with mature Sturmers stored in fully loaded chambers.

SEASONAL NOTES.

THE FARM.

CATCH-CROPPING OR FALLOWING.

LAND that has grown millet, maize, turnips, or similar crops, and is required for cropping purposes or sowing down in pasture next spring, should now either be sown in catch-crops to provide early spring feed, or ploughed and allowed to lie fallow during the winter so that frost may mellow the soil. The lighter soils are better sown in catch-crops, as the latter help to control weeds and prevent leaching. On the other hand, stiff wet soils will greatly benefit by a winter fallow. For fallowing, the ploughing should be deep and the furrow thrown up as rough as possible, so as to expose the greatest surface to the weather. Among suitable catch-crops are Black Skinless barley, Algerian oats, and Cape barley (2½ bushels to 3 bushels per acre), or a mixture of Cape barley, rye-corn, and oats (1 bushel of each per acre). The Black barley will come away the quickest and provide the greatest amount of fodder. In several tests both cattle and sheep have shown a very marked preference for the Black barley as against Cape barley or oats. If a heavy crop of green material is desired for cutting and feeding out during August and September, Ruakura or Garton oats should give good results.

WINTER WHEAT.

On most of the wheat-growing lands of Canterbury and North Otago the month of May should mark the commencement of sowing. It is true that on specially rich soils very early sowing tends to produce an excessive growth of straw, the result being difficulty in harvesting due to lodging of the crop. On the whole, however, it is desirable to start sowing as early as possible in May.

Pickling for Smut.

This precaution should never be neglected, and the formalin treatment is recommended. When properly carried out this does not affect the germination of the seed. Bluestone, on the other hand, while no doubt an excellent smut-preventive, does have a harmful effect on the germination. Exhaustive tests in the use of the formalin method for the control of bunt (stinking smut of wheat) have been conducted in England, and the treatment endorsed in the *Journal of the Ministry of Agriculture* is as follows :—

(1.) The seed in a heap is sprinkled with diluted formalin solution (1 pint formalin to 60 gallons water = 1 fluid ounce to 3 gallons water). Two gallons of the solution must be used to every 4 bushels of wheat. The seed is shovelled over and over until all the grains are wetted; the solution must not be allowed to form pools under the heap in which the grains might soak. (2.) The heap of wetted seed is covered over for four hours (not longer) with sacks which have been soaked in the diluted solution; the sacks should be uniformly wet, but not dripping. (3.) The heap is then spread out to dry in a thin layer on a clean floor. If the floor has previously been used for untreated wheat it should be wetted all over with the diluted formalin solution, and allowed to dry before the

treated seed is spread on it. (4.) Precautions must be taken to prevent the recontamination of the treated seed—*e.g.*, sacks which have held untreated contaminated wheat must not be used for treated seed unless they have been soaked in diluted formalin solution or boiled in water. (5.) The treated seed when dry should be sown as soon as possible.

Another method used successfully is to soak the wheat for seven minutes in the solution prepared as above, each sack being divided into two equal parts to facilitate handling. The wheat is allowed to drain after soaking.

For those who still prefer the bluestone treatment the following is recommended: Dissolve 1 lb. copper sulphate (bluestone) in 5 gallons water (using wooden or stoneware receptacle), and, spreading the grain on a clean floor, sprinkle at the rate of 1 gallon of the solution to 4 bushels of grain. Mix thoroughly and sow as soon as dry enough to handle satisfactorily.

The foregoing treatments have no effect on loose smut of wheat, and it is very necessary to get samples free from this pest for seed purposes. Varying strengths of formalin and bluestone solutions are recommended by different authorities, and it must be remembered that, particularly in the case of bluestone, a too strong solution has considerable harmful effect on germination. Dry-dusting methods with copper carbonate, &c., have not yet been adopted in New Zealand, but experimental work is proceeding.

ROOT CROPS.

Mangolds, carrots, and swedes are still growing, but the latter, where sown at the normal time, will be approaching maturity in May. This crop should be carefully watched for dry-rot, which shows up on the outside of the bulb. If much of this is present, feeding-off should be pushed ahead, as it is better to put the swedes into live-stock, even if somewhat early, than allow them to decay. If a swede crop is sound at this period it will usually keep well through the winter.

Harvesting Mangolds.

The mangold crop will be fit for harvesting in May and June. Where the area is large and labour comparatively scarce the roots can be left standing till within a couple of weeks of feeding, when they should be pulled and left on the surface. This practice, however, is safe only in districts where a mild winter is experienced, and storing is the better plan. It is quite possible to harvest mangolds too early, which leads to imperfect ripening and gives them a tendency to shrink unduly: it is best to wait till the leaves become limp. Provided the soil is not sticky at the time, trimming is unnecessary and even undesirable, as it may cause bleeding. The mangolds should be pulled by the left hand, the tap-root cut off by the right hand with a knife, and the top severed as the root is thrown into the dray or on to the heap. An experienced man can make very quick work of this. Some growers use a home-made implement shaped after the fashion of a snow-plough to push the roots out of the ground and into rows, the tops having been previously fed off with broken-mouthed sheep or chopped off with a sharp hoe.

Storage clamps or pits should be situated on dry ground and fenced off from stock: 5 ft. high on a basal width of 5 ft. is a convenient

size. Larger dimensions are often used, but the roots should then be left for several days in the paddock to avoid undue sweating in the clamp. In any case the clamp should not be completely covered for a week after it has been built. Clean wheat-straw is the best covering-material, but oat-straw, bracken-fern, and hedge-trimmings are also useful. A few sods or shovelfuls of earth should be put on to prevent high winds blowing the straw off, and in cold districts this earth can be made into a solid covering against frost. If Long Reds are grown with other varieties the clamp should be arranged so that the Long Reds may be used last. Owing to their superior keeping-qualities they are valuable for pig-feeding, &c., till the end of December.

As a rule, mangolds should not be fed before the middle of July; unripe, they are not only a wasteful but a dangerous food. They are of greatest value after midwinter, and when calving and lambing have commenced.

LUCERNE.

The winter months are the resting-period for the lucerne-plant, and in no circumstances should a stand be heavily grazed during that period. A few calves or other light stock may not do a great deal of damage, but the ideal practice is to give the stand a light cultivation if the land is dry enough, and let it run through the winter with a little rough growth on it. If the land is wet do not cultivate. Lucerne is generally grown to provide heavy crops of hay, ensilage, or green feed during the summer, and if it is knocked about during the winter the returns are greatly reduced.

Established stands, whether broadcast or in rows, if not already cultivated, will benefit greatly by earlier autumn working. This should be done thoroughly to a depth of 4 in. or 5 in. Where stands have been sown in 7 in. rows the advantage of this method over actual broadcasting is apparent at time of grubbing. The Planet Jr. No. 42 is a very useful implement for this class of work.

POTATOES.

The main crop should now be lifted before cold wet weather sets in. It is of great importance that the tubers be dug in a dry, clean state; if at all wet they should be left for some hours to dry before being bagged.

There is evidence of the potato-moth (*Lita solanella*) being rather plentiful in South Canterbury this season. Tubers containing the grub of this insect should be boiled and fed to pigs, and not pitted with sound ones. In cases of badly infected crops which are being used for pig-feed the pitting should not be done until after a few good frosts, which will effectively kill the grubs.

ARTICHOKES AND PIGS.

Considerable areas of artichokes are now grown for pig-feeding. They may be stocked any time now, but, if not required, stocking may be deferred until June or July, and feeding may continue until the end of August. In feeding-off it is not desirable to make the breaks too small, as they become badly puddled if the weather is wet; $\frac{1}{4}$ acre for twenty-five to thirty pigs is quite small enough. Feeding should continue until the pigs appear to find difficulty in getting

sufficient food. If removed then there will generally be plenty of seed for the next crop. It is, however, just as well to fence off a small corner to preserve seed, in case it is required to fill up gaps the following season. Pigs on artichokes should be provided with a dry bed. A fair crop should carry sixty store pigs per acre from eight to ten weeks.

---*Fields Division.*

THE ORCHARD.

GENERAL WORK.

THE end of the present month will see picking almost completed, only a few late varieties remaining to be gathered. If mid-season varieties have been held other than in cool store a careful watch should be kept to enable them to be placed on the market to the best possible advantage. All fruit held for some time after picking should be repacked before it is placed on the market, otherwise the buyer may have cause to complain, and this is not conducive to good business.

The close of the picking season affords a good opportunity for cleaning up in and around the orchard and packing-sheds. If it has been necessary to use props these should be gathered up and placed in a heap in one corner of the orchard, where they will be in readiness for the following season if required. Picking-cases, if not holding fruit, should be stored away in a shed ready for future use. All fruit rejected and unfit for the market or by-products should be cleaned up and disposed of, as such stuff becomes a source of danger from a disease point of view, besides being unsightly.

At this time of year it behoves every grower to take a retrospective view of the past season's workings, while at the same time looking forward to the coming season. All spraying results should be examined thoroughly. If there have been failures, investigation should be made to try and discover the reason. Where success has been achieved by the season's operations it must never be taken for granted that the same programme can be followed in detail the following season with the same results.

If spraying for the control of woolly aphis, as mentioned in last month's notes, has not been carried out no time should now be lost in making the application.

The heavy rains experienced during the late autumn and winter of last year should remind many orchardists of the necessity for making ample provision for the thorough drainage of all surface water. At the close of the picking season it is often good practice to plough the land, turning it towards the trees and thereby leaving an open furrow down the centre between each row of trees. Where water is liable to lie this will allow it to drain away freely. If cover-crops are growing, such ploughing is not always practicable, but in such case a furrow can be drawn at any place where there is danger of water accumulating. If this is done and outlets into proper channels are provided there will be little or no danger from surface water.

Preparation of land for the planting-out of trees should be pushed on with all speed before the winter rains set in.

—*L. Paynter, Orchard Instructor, Christchurch.*

CITRUS-CULTURE.

In bearing groves where fungicidal sprays have been applied there is little else of a routine nature to be done during the coming month other than the usual harvesting operations.

Where citrus-trees are grown on any class of gum-land much benefit is derived by the growing of leguminous cover-crops such as blue lupins. Growers are recommended to sow this crop wherever possible, for the purpose of improving the mechanical condition of the soil and for the addition of humus and nitrogen. May is one of the most favoured months for carrying out this work, and, provided weather conditions are suitable, growers concerned are advised to lose no time in its execution. A small dressing of superphosphate or basic slag at the rate of about $1\frac{1}{2}$ cwt. to 2 cwt. per acre at the time of sowing is recommended. For preference, sowing should be carried out with an ordinary farm drill.

Although there was not very much damage done in citrus orchards in the Auckland District by frosts last season, it is noticed that some growers have not yet completed the work of the removal of the affected portions. This work demands immediate attention.

STRAWBERRY-GROWING.

In cases where it is intended to lay down new beds of strawberries this season the work of preparation of the sits for planting out should now be well in hand. In the Auckland District new ground is usually preferred, owing to the absence of weeds on such. The soil which is considered to be most suitable for the cultivation of apples is generally found suitable for the growing of strawberries. Good drainage is essential, and deep tillage is necessary in the preparation of the soil. A very heavy soil or stiff clay is quite unsuitable for cultivation of the strawberry, as is also a very sandy soil which dries out too rapidly during the hotter part of the season. It is usual in the Auckland District to apply artificial fertilizers rather than to use stable or farmyard manure. Although, as above stated, new soil is generally preferred for the planting-out of new strawberry-beds, on account of the absence of weeds, it must be remembered that prepared soil will often give a much better result—that is, land which has been well worked the previous season and sown down in some leguminous plant, thus adding nitrogen to the soil. After the necessary cultivation has been completed the ground should be well rolled before the planting is undertaken, after which the drills may be made and manure applied.

Planting out is generally done when there still remains some warmth in the soil—namely, the latter part of April—in which case it is necessary to keep the surface soil well stirred whenever opportunity permits throughout the winter. In some cases early spring planting is preferred, but should the weather become very wet at planting-time the work is often handicapped and growth is delayed, whereas with the April planting the plant has sufficient time for good root-formation, and when the warmer weather sets in in the early spring growth commences immediately.

Regarding the selection of plants, Marguerite remains the favourite variety in the Auckland District, while in the Southern districts

Laxton's Noble and Melba hold pride of place. Others in favour include Phenomenal and Duke of Edinburgh. Before making their final selection, intending growers are advised to make thorough inquiries regarding several strains which are being offered, and only those strains which are considered to have proved themselves good fruiterers should be planted.

—J. W. Collard, *Orchard Instructor, Auckland.*

POULTRY-KEEPING.

THE PULLETS AND WINTER-EGG PRODUCTION.

Now that the dear-egg season is at hand the poultry-keeper's chief concern will be the care of his pullets—studying their requirements and making the conditions as ideal as possible in order that a maximum result may be secured. If this desired end is to be attained there must be no half-measures in the chain of management. Obviously if a pullet is to produce her out-of-season product in good number she must be given every assistance to do so. In the first place she must be made comfortable, as only in this condition can she be expected to lay heavily. This implies that the house must be roomy and well ventilated, but without draughts, and partly opened up in front in order to admit as much sunlight as possible. The floor should be well littered with straw. The grain food should be well scattered in the straw as a means of compelling the birds to exercise in finding the grains. Above all, as a preventive against colds, it should be seen that there are no cracks in the sides or back walls. Even the partitions in the houses near where the birds are roosting should be free from draughts. The walls should be tested for draughts at night with a lighted match.

Among many poultry-keepers there is a tendency to wait till colds make their appearance and then to resort to curative measures. This is a mistake. Similarly to most other troubles affecting poultry, prevention is the only safe course of dealing effectively with this one. It may happen that only one or two birds contract a cold as a result of sleeping near a crack in the wall, but usually from these the trouble will rapidly spread through the flock. Once a flock of pullets become affected with colds their egg-yield rapidly declines, and in spite of all that is done for them they will bear an unkempt, miserable appearance. Thousands of winter eggs are lost annually from no other cause. Not only this, but colds are the forerunner of roup, and once this dreaded disease gains a foothold there is no telling when it will be stamped out.

Cleanliness is another important preventive factor against disease and insect pests. The droppings should be frequently removed, and at frequent periods the perches given a good application of kerosene or a strong disinfectant.

Food-quality and the Ration.

The poultry-keeper should make sure that the food supplied is of the best possible quality quite irrespective of cost. With any class of poultry it is always poor economy to feed damaged or musty food because it is cheap. Especially is this the case with pullets at this

period of the year. They will simply refuse to eat such food (unless, of course, forced to by hunger), and obviously a declining egg-yield will result. With eggs selling in the region of 3s. a dozen it will pay to feed nothing but the best, and as much as the birds can consume of it. There is no danger of overfeeding the laying bird with food of the right quality, provided she is given ample opportunity to exercise.

The morning mash may consist of two parts of pollard to one of bran by measure. This should be made as appetizing as possible by moistening it with meat soup, skim-milk, &c. When these liquids are not available boiling water should be used. A mash moistened with the latter will be much better relished by the birds than when cold water is used. Where a good grade of pollard is not available (much of it these days is more like bran than the genuine article) a mixture of one part of finely ground good-quality wheat to two parts of bran can be depended upon to give better results than can be obtained with inferior pollard. The mash should be mixed to a crumbly consistency, not sloppy. Feed only what the birds will pick up clean in, say, twenty minutes. If mash is left before them at all times they will eat this and fail to take the necessary exercise by scratching for the grain ration in the litter, in which there should always be odd grains of food for the birds to fossick for.

In the evening and well before dark give a full meal of grains, such as equal parts of wheat, oats, and maize. It is always a good plan to give more at this meal than the birds require, as what is left will induce them to scratch and keep busy when they leave the perches in the morning. If it is observed that one of the grain foods mentioned is being left it should be fed in a reduced quantity.

Forcing-food.

To secure a maximum winter-egg yield a forcing element must be included in the ration. This denotes highly nitrogenous substances such as meat, meat-meal, blood-meal, milk, &c. While a forcing-food is specially demanded for the manufacture of the artificially stimulated egg-product of the modern fowl, it is nevertheless always best to chiefly feed this separately, so that each bird may only take what it needs. Nature will usually guide it in this respect. When these rich foods are included in the morning mash, and the birds are compelled to eat more of them than they require in order to secure a meal, ovarian troubles such as protrusion of the oviduct are almost sure to follow. In a general way, where boiled meat is available it may be fed in the proportion of 1 oz. to each bird per day. Where meat-meal is used as a substitute it may be judiciously supplied in the morning mash in the proportion of, say, 6 per cent. of the entire mixture. It may also be available in a separate receptacle for the birds to pick at, and in this way those birds which crave for a larger share will be able to secure it. It will generally be found that the greater the layer the greater will she crave for animal food.

Naturally, if it is observed that ovarian troubles are making their appearance and that many shell-less or double-yolked eggs are being produced, the forcing-diet ~~should~~ be reduced accordingly, as this indicates that the birds are eating more of the forcing-food than is good for them.

Green Food, Grit, Lime, and Water.

Green food is another important matter in the ration of the laying bird. It should be provided every day with a free hand, otherwise the digestive system will become deranged, and the health of the birds will rapidly decline as well as the egg-yield.

Sharp gravel-grit is also an essential for the well-being of fowls. Its chief function is assisting the grinding process of the grains in the gizzard. Lack of hard grit is a common cause of digestive troubles and unthrifty flocks.

Lime is also necessary to provide egg-shell-forming material. A good way of supplying lime is in the form of crushed fresh oyster or other sea shell. It is a mistake to mix grit and shell together, or to have them in a small, narrow receptacle. The birds should have free access to these materials in order that they may be given an opportunity of picking up the pieces they most desire.

Clean fresh water should be available to the birds at all times. It should be remembered that an egg contains about 60 per cent. of water, so that neglect to keep the water-vessels filled will obviously mean a falling-off in eggs. Where milk is available it may be given in large quantities to drink at this period of the year. There is nothing better as a substitute for meat and for promoting egg-production. If there is any doubt about this the poultry-keeper should try one pen of birds with milk and another without, and watch results.

Finally, it should be always remembered that winter eggs are an artificially stimulated product, and unless artificial methods of management are resorted to in the way of good housing, plenty of nourishing food, and careful management the best bird ever bred cannot be expected to produce them.

-F. C. Brown, Chief Poultry Instructor.

THE APIARY.

UNITING COLONIES.

THE presence of weak hives in the apiary must be avoided as far as possible. During the warm autumn days these colonies rarely escape the attention of robber bees, and are easily molested. When once they are attacked the beekeeper will find it extremely difficult to save them, and eventually they will get robbed out despite his efforts. It is far the better plan to unite the bees with a stronger colony than to run the risk of unsettling them in the dormant season through the encouragement of wholesale robbing. A simple method of uniting colonies was explained in the February issue of the *Journal*.

COVERS.

With the approach of the rainy season it is advisable to make a complete examination of the hive-covers in use. Altogether too little attention is paid to making the covers watertight, and neglect in this direction leads to winter losses. No amount of labour should be spared in saving the bees from exposure and dampness, and by so doing warding off the large annual losses that occur through neglect. There is no excuse for the beekeeper neglecting to protect his bees, and he

will find in the long-run that a small expenditure on some suitable waterproof roofing-material will doubly repay him, and will be the means of saving colonies that would otherwise be lost. Bees must be kept dry. An examination made of colonies where proper protection is not provided will reveal the presence of large quantities of propolis. Usually this is collected to prevent the penetration of external moisture, and it is noticeable that it is gathered freely in the autumn months. Where adequate protection is provided the bees are to a large extent saved the labour of collecting the propolis, and by providing dry roofs the beekeeper is assisting them. In the case of roofs that are cracked do not attempt to tinker with them, but cover entirely with some waterproof material. In the long-run metal coverings are the cheapest and the best. Good zinc or galvanized iron makes ideal covering, and will last for years. Quite a number of beekeepers are now using ruberoid or similar materials with very good results. While not so durable as metal, they serve the purpose admirably, and with careful treatment will last for a number of seasons.

SPARE SUPERS.

Where extracted combs have been placed on the hives for the bees to clean up, these should be removed and the bees confined to as small a space as possible consistent with the size of the colony. It may be necessary to leave some of the supers on during the winter months, and these can be dealt with in the spring. Do not leave the bees more space than they require, as it will be found that they will desert the lower supers and cluster at the top for warmth.

MATS.

See that each colony is provided with one or two good mats during the winter months, to keep the bees as warm as possible. Mats should be cut to fit exactly on top of the frames, and may be made from clean sacking or canvas. Sugar-bags or cornsacks make excellent mats and are easily procured. Wood mats are adopted by some beekeepers, and, if desired, may be secured at a moderate cost from dealers in bee material. In districts where the bees do not bring in a great deal of propolis wood mats are effectual. On no account use calico mats, as these afford practically no warmth.

WEEDS.

The hives should be kept clear of all weeds, so that the flying bees may have free access to the entrances. Many bees are lost by striking growing obstacles on returning to the hives. For the next few months, when the air is charged with moisture, it is important that plenty of air and as much sunlight as possible should penetrate beneath the bottom-boards. In damp situations place the hives sufficiently high from the ground to avoid the dampness. Old bricks or concrete blocks make admirable supports for the bottom-boards. Make sure that the hives have sufficient cant towards the front before the winter rains set in. The presence of much moisture on the bottom-boards will be the means of much loss to the beekeeper, and, in addition, cause the hives to become sour and foul-smelling.

SHELTER.

Where the hives are exposed it is essential that suitable artificial shelter should be erected. Brood-rearing must be encouraged until a

late date, and this will not be carried on by the bees if there is a lack of shelter. It is necessary to prevent the keen driving winds from gaining access to the hives, and the consequent bad effects of chilling the brood. In most districts there is an abundance of manuka scrub, and this affords capital shelter when erected in the form of a breakwind. On no account place hives under high evergreen trees with the idea of affording shelter. This is one of the worst locations, as the trees prevent the entrance of the sun's rays, and there is invariably a cold draught between the trunks.

CARE OF COMBS.

Good extracting-combs are the most valuable asset the beekeeper possesses next to his bees, and great care should be taken to secure them from the ravages of the wax-moth and mice. Hundreds of combs are destroyed annually through carelessness, and this can be prevented by attention to small details. Mice destroy the combs to gain access to the pollen and honey, and render the best combs foul and distasteful to the bees. Combs can be stacked in a mouse-proof room or in supers tiered one above the other. Queen-excluders may be utilized to keep mice out of the combs, and in the absence of close-fitting roofs are a complete success. If the presence of the wax-moth is detected the tiers of combs should be fumigated. Bisulphide of carbon is effective in destroying insect-life, but should be used with great care, as it is highly inflammable. Prevention is better than cure, and a few moth-balls placed in the supers will prevent the attack of the moths.

—E. A. Earp, *Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

As soon as the asparagus foliage ripens, and before the seed drops, it should be cut down and removed. Care should be taken to cut it just below the surface of the ground, and so avoid the awkward stubble that is sometimes seen. Clear the beds of weeds by light forking or hoeing. Winter rhubarb should now be ready for moderate pulling. Early peas may be sown in warm localities.

GARDEN-MAKING.

While the best time for garden-making is the autumn, if the work is at all extensive it has frequently to be left till winter, when more time is available. Thorough preparation is so important that such a delay is to be preferred to making a hurried job earlier in the season.

Shallow-worked lumpy ground with half-rotted turf, or a bad infestation of couch-grass, docks, or other weeds, is too often the condition the grower has to face when starting a crop in spring. Satisfactory results can be obtained only from land that is clean and deeply cultivated, well manured, and in good tilth. These conditions will be obtained by different methods, each circumstance requiring special consideration; but, whatever the method, considerable time and labour are needed. Hurried preparation late in the season, followed immediately by the sowing or planting of the crop, accounts for most of the disappointing results that are met with.

• If the area to be dealt with is large and in grass it may be skim-ploughed now and allowed to remain, say, for six weeks or two months, until the turf is thoroughly rotted. It should then be cross-ploughed deeply and subsoiled. Such harrowing as may be required should then follow.

If the section is small and unsuitable for ploughing it is usually best dealt with by trenching. To do this, open a trench at one end across the full width of the section, making it rather wide and about 1 ft. deep or to the top of the subsoil. The soil thus removed should be taken to a position convenient for filling the final trench. Now dig the bottom of the trench over, but do not lift out the soil. Skim the vegetation from a similar width adjoining, and lay it on the bottom of the trench just opened. Proceed to open trench No. 2, and in doing so fill trench No. 1, and continue in this way till the job is completed. Such methods will secure the necessary deep cultivation and tilth. As seedling weeds appear, put the hoe over the ground in fine weather, and by the time the planting season arrives the crop will start under the best possible conditions.

There is still the matter of manuring to consider. It is the custom among market-gardeners to use very large quantities of manure—quantities far in excess of the theoretic needs of the crop. Different soils and different crops require different treatment; the successful grower must study this matter very closely. The subject is gone into fully in the *Journal* for June, 1923, page 372. At this season the slower-acting organic manures may be incorporated with the soil when trenching or ploughing; or if the ground is already rich or inclined to be sour an application of 1 ton of lime to the acre would be an advantage. It should be broadcasted and harrowed in. The application of the more soluble manures is best left till the spring.

These are the secrets for growing successful crops, and poor preparation is the cause of most of the disappointing results. Such preparation as detailed above is specially necessary in the case of crops that are to remain in the land for some years, such as asparagus, rhubarb, strawberries, &c.

It is usual to select naturally well-drained land for garden purposes, but should the land be at all waterlogged at any time it must be drained and the drainage maintained in working-order.

LAWNS AND FLOWERS.

The winter management of lawns is important. Most lawns could receive more rolling with advantage, and an application of basic slag now would benefit many plots. Lime should be applied with caution, owing to its tendency to encourage clovers. The turf will be all the stronger if the grass is allowed to grow rather longer than usual during the winter months.

Lift gladiolus bulbs as soon as the foliage withers; ripen the bulbs off and store them in a dry place. Narcissus bulbs will be making growth, and may be assisted where necessary by the application of suitable manures. Pansies, stocks, wallflowers, &c., for spring blooming should now be well established in their permanent quarters. Keep them clear of weeds, and fill up any gaps that occur.

—William C. Hyde, *Horticulturist*.

NEW ZEALAND INSTITUTE OF HORTICULTURE.

THE following notes are contributed by Mr. George A. Green, honorary secretary of the Institute.—

The close of March, 1924, seems to be a fitting time to review the work in connection with the organization of the Institute of Horticulture. During the year the provisional committee has registered the Institute, and quite a large number of those interested in horticulture, scattered over the Dominion from the north of Auckland to Invercargill, have signified their intention to link up with the movement. The New Zealand Association of Nurserymen has passed the necessary resolution for affiliation, while the New Zealand Fruitgrowers' Federation is contemplating a similar move. Applications for membership have also been received from some half-dozen horticultural societies and district fruitgrowers' associations. Addresses have been delivered by the honorary secretary in some twelve different centres.

Among the practical work of the year has been the continuation of the bud-selection work by the Teviot Fruitgrowers' branch of the Institute. Up to 28th February, 1924, about sixty thousand certificated buds of the six leading varieties of apricots recommended for commercial planting have been sent out to the fruit-tree nurseries for propagation, and it is estimated that for this year's planting season 90 per cent. of all the young apricot-trees available are from the selection committee's wood. Investigation continues in several centres into the relative merits of certain stone-fruits, while in Tauranga and Auckland it is hoped shortly to start citrus bud-selection in connection with commercial citrus culture.

A distinct advance has recently been made in connection with the development of the Institute by the formation of committees at both Dunedin and Christchurch, with a view to establishing permanent district councils of the Institute at both the southern centres. The Dunedin chairman is Mr. T. K. Sidey, M.P., and the committee includes Mr. David Tannock, F.R.H.S., and several leading citizens. At Christchurch a representative committee was formed with Dr. C. Chilton, Rector of Canterbury College as chairman. The need for horticultural education appealed to the gathering at both centres, and the hope was expressed that a school of horticulture might be speedily established. At the moment movements are afoot with the object of starting district councils of the Institute at Auckland, Palmerston North, and Wellington. At the latter centre Dr. I. Cockayne, the distinguished botanist, has associated himself with the movement, and has placed his services at the disposal of the council of the Institute.

Much remains to be done, but the progress made must be considered very satisfactory. Given loyal support and the necessary financial assistance to enable the organization to be carried on to a successful issue, we may soon hope to see the New Zealand Institute of Horticulture taking its rightful place in the activities of the Dominion and exercising its functions in connection with higher horticultural education.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* for 6th and 20th March and 3rd April, 1924, include the following of agricultural interest:—

No. 48428: Milking-machine milk weighing and sampling apparatus (C. M. Wright, Manunui). 49546: Seed-sower (A. H. Constable, Penshurst, England). 49742: Scythe-stay (W. T. Thompson, Tariki). 51010: Rabbit-exterminating apparatus (F. W. Parker, Box Hill, Victoria). 51273: Soil-cultivating implement (D. A. Dunn, Gore). 51369: Honey-extractor (W. Herrod-Hempsall, Luton, England). 51382: Milk-cooler (C. F. Vincent, Huirangi). 51447: Milk-agitator (L. Kjar, Masterton). 49783: Plough (D. M. McLaren, Pataroa). 50237: Milk-agitator (D. MacMillan, Clandeboye). 51075: Milking-machine pulsator (C. T. Newton, Merino, Victoria). 51459: Milking-machine teat-cup (G. M. Wallace, Hamilton East). 49743: Milking-machine teat-cup (W. T. Thompson, Tariki, and C. J. Twigg, Lepperton). 51284: Wool-bale-stacking device (W. Webb, Mataimoana). 51291: Incubator (H. J. L. Williams, Spreydon). 51427: Meat treatment and storage (J. A. Linley, London). 51474: Milking-machine pulsator (J. G. Lamb, Melbourne).

Copy of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

BREEDING FERRETS.

"FERRETS," Maungatautari, Cambridge :—

I have four female ferrets that I would like to breed from. Will you kindly give me a few particulars as to the length of gestation and proper handling of young in the early stages, also state if there is any particular breeding season? I keep ferrets solely for assisting me to combat the rabbit pest, and want to breed my own instead of having to buy others to replace losses.

The Live-stock Division :—

The gestation period of ferrets is six weeks, at the end of which time the young are born, hairless, blind, and deaf. There are usually six to nine in a litter, two litters being produced each year, the second commencing as soon as the first have been weaned. In New Zealand the bitch ferret comes on season about October or November. The period of oestrus lasts about three days, during which time the vulva is much swollen and protuberant. When about to bring forth young the female should be given a good straw bed, and then left as much alone as possible till the young are about ten to fourteen days old, as she has a tendency to eat her offspring if she is worried by being watched or by the place being cleaned out. The eyes of the young do not open for about twenty-eight days. The male ferret must, of course, be separated from the female at this time. Ferrets require a good closed-in pen with straw for sleeping-quarters and a yard in which they can feed and get exercise. If not kept scrupulously clean they are liable to contract distemper or get sore feet or become lousy. As soon as the young are old enough they should be handled and thus tamed for their work of rabbiting. You will probably find that ferrets kept in captivity do not breed after the first year as regularly as expected.

RENOVATING A PASPALUM-DANTHONIA PASTURE.

"SUBSCRIBER," Wayby :—

Please advise me how to renovate a worn-out pasture, principally paspalum and danthonia, without ploughing.

The Fields Division :—

You are advised to well disk-up the paddock in July. Then harrow, roll, and sow a mixture consisting of—8 lb. perennial rye-grass, 3 lb. Italian rye-grass, 2 lb. white clover, 3 lb. red clover, 1 lb. subterranean clover, and 1 lb. Lotus major. Mix the seed with 3 cwt. of a mixture of basic slag and superphosphate in equal parts. Follow the sowing by light harrowing.

HARES AND OPOSSUMS IN THE ORCHARD.

"SUBSCRIBER," Lower Hutt :—

I am pestered with hares and opossums, and would be obliged if you could advise me how to get rid of them so as to be within the law. I have an orchard, and the loss is very serious, as they strip the trees of nearly all the fruit, break boughs, &c. My boundary-fence is adjoining the bush.

The Horticulture Division :—

Hares are best kept out by putting up a wire-netting fence. In some places growers are able to protect their trees by spraying the lower parts in spring with a strong lime-sulphur wash with a little extra lime added, but in such districts attacks are practically confined to late winter and early spring, when possibly feed for the hares is scarce. The Animals Protection and Game Act,

1921-22, allows opossums to be taken at any time without license in any orchard registered under the Orchard and Garden Diseases Act, 1908, or within half a mile thereof, by the occupier of such orchard or by any *bona fide* employee of the occupier. All skins so taken and which it is proposed to dispose of must be stamped by an authorized officer and a royalty of 1s paid thereon within one month from the date on which the skins were taken. No person may dispose of opossum-skins for gain unless sold to or by a licensed broker. Skins retained for a person's own use must also be stamped and a royalty of 1s paid thereon within one month from the date on which such skins were taken.

REARING A MOTHERLESS FOAL.

“MOTHERLESS,” Highbank :—

I have a foal that lost its mother at the age of two weeks. I have fed it on milk up to now, but have started to give it ground linseed and oatmeal. Will you kindly advise me as to the best and proper manner of feeding?

The Live-stock Division :—

The following procedure is recommended: To 20 oz. (1 pint) of cow's milk add 5 oz. of boiled water and 1 dessert-spoonful of sugar. Feed this to the foal five times daily, increasing the amount gradually as the animal grows, until it is taking from 7 to 8 quarts daily. One cup of linseed-gruel, made by simmering whole linseed in a little water, may be added two or three times a week. Induce the foal to eat crushed oats by placing a small quantity in a convenient place. The animal should be protected from all cold and wet weather, but during the daytime in warm weather it should be allowed to run on a good, clean pasture. Later on it should be allowed free access to good, clean water. If constipation occurs at any time you could give up to 3 tablespoonfuls of castor-oil, according to the size of the foal at the time.

CONTROL OF FOXGLOVE.

“WEED,” Raetihi :—

Will you kindly give me what information you can regarding foxglove? Will it die out in time? Is pulling it out the only way of getting rid of a fair quantity of it?

The Live-stock Division (Noxious Weeds Inspection) :—

Foxglove when once firmly established, especially in bush-cleared lands where logs and stumps abound, is a most difficult plant to eradicate, as it is a biennial and a very free seeder. If it already has a good hold on the land all that can be done (if the land is unploughable) is to pull up or cut down, to prevent seeding, the whole of the plants that appear. This carried out for a number of years should have the desired effect of eventually eradicating the weed. This entails a good deal of work unless done when the plant first makes its appearance. In cutting or pulling the plants the work should be done before the plants are in full flower, as the flowering-period is fairly long and seeds will have matured on the lower stem before the upper portion has finished flowering. When eradication is aimed at foxglove should be dealt with twice yearly: firstly, when the flowering-stems are developing the plant should be pulled up, and, secondly, during the blossoming-period any standing should be cut down or pulled up. Any small plants that are not in flower should also be pulled up or chipped out. If it is dealt with in the early stages of its spread it may be eradicated in a few years by these means, but where it has infested the land for a number of years and has been allowed to deposit its seed young plants will keep springing up for several years. Statements have been made that if left alone for a number of years foxglove will eventually die out, but we would certainly advise you not to wait for such a result, whether the plant has been declared a noxious weed or not. In districts where it has been declared to be a noxious weed by the local authority the Noxious Weeds Act requires that it shall be cut down and kept cut down, or grubbed or pulled up to prevent the spread thereof by seeding or otherwise.

WEATHER RECORDS : MARCH, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE outstanding features of the month of March were warmth and high humidity, especially in the North. In the latter part of the month drought was experienced in many parts of Otago, with considerable heat.

It is several years since one month has shown such a succession of ex-tropical disturbances as have lately dominated weather conditions in the North. The South, on the other hand, was really affected by only one westerly disturbance, between the 7th and 10th, though two others passed southward of the Dominion on the 13th and 19th. Barometric pressure was mostly above normal over the Dominion from the 1st to the 7th and from the 16th to the end of the month.

The first few days of the month were generally hot and humid, and on the 6th some remarkable rain fell while the barometer was still high, electrical conditions being evidently responsible for the downpours. Between the 7th and 16th barometric pressure was lowest in the North, and strong north-east to south-east winds ruled. Heavy rain and thunderstorms were experienced on the 10th in several parts—for example, at Hawera, 4.20 in. were registered at the post-office, 5.37 in. at Argyle Street, and at the trout-hatcheries, two and a half miles away, the fall amounted to 9.09 in.

There had been a very dry period in Canterbury, and the 9th was exceptionally hot, 89.8° F. being registered at Christchurch. This was followed by thunderstorms on the 10th, and some very beneficial rains of 1 in. and upwards occurred. In the high lands of the province the rainfall was abundant, the Hammer observer remarks that the month was exceptionally wet and that there was a total absence of high winds. Other parts did not escape gales, and one in Cook Strait on the 11th was described in the Press as "the worst for thirty years."

On the 11th a tremendous downpour occurred in the vicinity of Napier. At Eskdale the gauge overflowed, but 17.90 in. of rain was measured in one day. 13.56 in. at Tutira, and 17.15 in. at Riverbank. At Napier the observatory (which is at present somewhat sheltered) recorded 8.03 in., but 10.90 in. was registered at the residence of Mr. J. H. Coleman. These falls were very local and due to the influence of a thunderstorm. At Hedgely, Eskdale, thunder and lightning were observed at 5 a.m. and continued at intervals until dark. Mr. T. P. Clark (the observer) reported that the River Esk rose very quickly to about 4 ft. or 5 ft. higher than previous records, and that a creek running into it had backed up to 25 ft. above normal. The damage done by the floods was serious to roads and bridges, and there were losses of stock; but Hastings, Maraekakaho, and other places in the vicinity escaped the cloud-burst (any excessive and prolonged fall in a locality is described as a "cloud-burst").

Total rainfalls were generally above the average, but below it in many parts of Canterbury and on the west coast of the South Island, as well as in the whole of Otago.

—D. C. Bates, Director.

RAINFALL FOR MARCH, 1924, AT REPRESENTATIVE STATIONS.

Station.				Total Fall.	Number of Wet Days.	Maximum Fall.	Average March Rainfall.
<i>North Island.</i>							
				<i>Inches.</i>		<i>Inches.</i>	<i>Inches.</i>
Kaitaia	..	..	..	3.88	10	1.64	3.58
Russell	..	..	..	6.13	16	2.70	3.42
Whangarei	..	..	..	7.33	16	2.16	5.10
Auckland	..	..	..	3.63	16	1.31	3.06
Hamilton	..	..	..	6.11	18	1.73	3.74
Kawhia	..	..	..	5.33	11	2.69	3.12

RAINFALL FOR MARCH, 1924—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average March Rainfall.
<i>North Island—continued.</i>				
	Inches		Inches	Inches.
New Plymouth	6.56	13	2.35	3.46
Inglewood	9.53	14	3.48	7.39
Whangamomona	6.48	11	2.10	5.46
Tairua, Thames	9.58	15	4.09	6.73
Tauranga	7.01	15	2.18	4.18
Maraehako Station, Opotiki	4.10	10	1.40	3.90
Gisborne	10.20	17	4.98	4.60
Taupo	2.22	9	0.84	3.53
Napier	10.80	11	8.03	3.40
Maraekakaho Station, Hastings	5.43	13	1.78	3.10
Tauhape	7.36	14	2.50	2.60
Masterton	3.36	15	1.07	3.23
Patea	3.80	10	1.69	3.60
Wanganui	2.20	8	1.49	2.60
Foxton	1.44	8	0.34	2.36
Wellington	4.75	13	2.07	3.27

South Island.

Westport	5.31	13	1.12	5.80
Greymouth	6.64	10	1.58	9.12
Hokitika	6.30	14	1.86	9.72
Arthur's Pass	4.68	7	1.78	5.84
Okuru, Westland	10.26	11	3.24	15.48
Collingwood	8.83	14	2.52	4.19
Nelson	7.20	12	3.72	2.99
Spring Creek, Blenheim	3.26	10	1.20	1.81
Tophouse	4.58	15	1.17	3.44
Hanmer Springs	5.23	14	1.63	2.84
Highfield, Wairau	4.79	11	2.45	3.09
Gore Bay	4.40	10	1.43	2.14
Christchurch	1.56	12	0.46	2.11
Timaru	1.42	12	0.22	2.45
Lambrook Station, Fairlie	1.40	9	0.42	2.58
Benmore Station, Omarama	3.10	8	1.16	2.64
Oamaru	1.55	7	0.76	1.77
Queenstown	1.02	5	0.61	2.63
Clyde	0.81	5	0.42	1.50
Dunedin	1.13	9	0.60	2.99
Gore	1.11	9	0.44	3.23
Invercargill	0.97	14	0.50	3.86

British Market for Peas.—The following report was cabled by the High Commissioner, London, on 5th April: *Peas*—Market for blue is depressed in consequence of heavy arrivals from Japan. Best Japanese hand-picked marrow-fats ex store, £20 5s. to £20 15s.; April/May shipments, £19 10s. per ton c.i.f. Tasmanian "A" grade, March/April shipments, worth about £19 10s. per ton c.i.f. New Zealand ex store, slow sales at £16 to £19. English maple plentiful at 55s. to 65s. per quarter. Nominal values ex store of New Zealand maple, 68s. to 74s.; Tasmanian, 87s. 6d. to 92s. 6d., and March/April shipments offered at 77s. 6d. c.i.f.

WINTER FARM-SCHOOLS, 1924.

THE Department has arranged courses of instruction for farmers in the various districts as follows. —

Auckland: (1) At Ruakura Farm of Instruction, Hamilton, 7th to 12th July; (2) at Dargaville, 30th June to 4th July. Enrolment with the Instructor in Agriculture, Department of Agriculture, Auckland.

Taranaki: At Stratford, 23rd to 28th June. Enrolment with the Instructor in Agriculture, Mōumahaki Experimental Farm, Waverley.

Wellington. (1.) At A. and P. Show-grounds, Solway, Masterton, 12th to 17th May, enrolment with the Instructor in Agriculture, Department of Agriculture, Palmerston North. (2.) At Central Development Farm, Weraroa, 2nd to 7th June; enrolment with the Farm Manager.

Canterbury: At Timaru, 5th to 10th May. Enrolment with the Instructor in Agriculture, Department of Agriculture, Christchurch.

Otago and Southland: (1) At Invercargill, 19th to 23rd May; (2) at Dunedin, 26th to 31st May. Enrolment with the Instructor in Agriculture, Department of Agriculture, Dunedin.

Details of the respective schools (programme, accommodation, &c.) will be published in the local Press in each case, but any further information desired may be obtained from the departmental officers specified above. Early enrolment is advisable.

STOCKS OF EGGS AND EGG-PULP, ETC., IN STORE.

ARRANGEMENTS have been made for the Government Statistician to obtain returns of the quantities of eggs in shell, egg-pulp, and frozen whites and yolks, held in cold store throughout the Dominion as at 31st March and 31st July respectively each year. The object of the return is to ascertain the quantity of eggs and egg material which it is necessary to store for consumption during the scarce season of production, and to obtain a guide as to the quantity of eggs that can be exported without interfering with the requirements of the local trade.

The return of stocks held in cold storage at 31st March, 1924, is as follows:— Eggs in shell, 44,942 doz.; egg-pulp, 840,889 lb.; frozen whites, 2,618 lb.; frozen yolks, nil.

FORTHCOMING WINTER SHOWS.

Canterbury A. and P. Association. Christchurch, 14th to 17th May.

Southland A. and P. Association: Invercargill, 21st to 23rd May.

Waikato Winter Show Association: Hamilton, 27th May to 3rd June.

Otago A. and P. Association: Dunedin, 3rd to 6th June.

Auckland Winter Exhibition: Auckland, 10th to 28th June.

Manawatu A. and P. Association: Palmerston North, 17th to 21st June.

Wellington Winter Show Association: Wellington, 5th to 12th July.

(Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.)

Quarantine of Imported Dogs.—During the past year the period of quarantine of dogs imported from the United Kingdom has been a clear six months at the quarantine station. An amendment to the regulations, gazetted on the 27th March, allows the period of six months to include the time from the date of embarkation of the animal in Britain to its removal into quarantine after arrival in New Zealand.



The New Zealand Journal of Agriculture.

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WELLINGTON, 20TH MAY, 1924.

THE GRASSLANDS OF NEW ZEALAND.

SERIES II. THE TARANAKI BACK-COUNTRY.

E. BRUCE LEVY, Agrostologist, Biological Laboratory, Wellington.

3. PRESENT-DAY POSITION OF THE HILL PASTURES AND CONSTITUTION OF THE PASTURE SWARD.

IT has been stated before that the two great factors in weed-control in our grasslands are (1) the formation of a close and continuous grass sward, and (2) the judicious feeding-down of that sward by different classes of stock. The sward of grass functions really in two ways. Firstly, by its actual occupation of the ground it competes with weeds established along with it, and by its cover prevents weed invasion. Secondly, in virtue of the feed it produces stock are enabled to be maintained on the area. Stock judiciously managed are really the most potent agents in the control of weeds, but stock cannot, in justice to themselves, be maintained on the area for long if the grass sward is absent. The grass sward, therefore, is all-important.

Of the Taranaki back-country in general it may be said that there is a very much larger area on the hills covered by secondary growth than by grass (Fig. 32). Along the easy sloping foothills there is usually good grass, but as one ascends the hills the grass turf weakens, herb-like weeds increase, and then one comes into the zones of various

classes of secondary growth, where it may be said that the pasture is non-existent. In a stocked area on such a slope the first zone of secondary growth is usually hard fern dominant, and manuka may be sprinkled among this. Above the hard-fern zone bracken usually predominates until one reaches the ridges, where usually, on the stock trails and camps, there is a good sward of grass. In certain places water-fern may take the place of hard fern.

The more or less zoning of the secondary growth is the outcome of the manner in which stock graze the area. The good grass at the bottom of the slope results from the greater soil-fertility, and from the fact that more stock graze and tread there. Higher up the hillside the bracken-fern has been crushed out as the stock have worked their way up, but the ground bared of this growth has seldom been sown with grasses after or during the crushing, and consequently weeds largely predominate. The area may be one mass of pipiriri. Almost all the bracken-fern areas of this country have gone through a phase in which hard fern previously existed. A smother of bracken for several years will kill out hard fern (see *Journal*, September, 1923, pp. 148-151), but should the bracken be crushed out while even a vestige of the hard fern remains alive there will be a return of the hard-fern trouble, particularly so where volunteer growth is allowed to populate the soil bared of the bracken growth. If suitable grasses and clovers were sown as the bracken was being crushed out it might be quite a different story. On these slopes, therefore, when the bracken is crushed out as the stock work their way up there is usually a return of the hard fern, which forms a zone, as it were, graduating into pure bracken higher up where stock have not yet wandered (Fig. 32).

In most old pasture areas, where stock graze over the whole paddock, very little bracken may be seen, but here the hard fern is well represented, either as isolated clumps dotted here and there, or numerous patches, or contiguous patches virtually occupying the whole surface. Pastures having from 30 per cent. to 90 per cent. of the sown area covered by hard fern are not uncommon, and, as a rule, with the turf of grass constituted as at present, the hard fern is on the increase. Manuka, again, is spreading, and this spread is due almost entirely to the open nature of the pasture sward. The foregoing applies to the areas poorly farmed. On the better-farmed portions there may be as little as 10 per cent. of secondary growth, some paddocks being virtually clean, but even among the best farmers of the district it is not too much to say that an average of 30 per cent. of the farm is growing nothing but hard fern, manuka, or other rubbish. When the production of these latter farms is considered, the grassland itself, even as at present constituted, must be yielding fairly high (Fig. 33).

CONSTITUTION OF PASTURES KEPT FREE OF SECONDARY GROWTH.

The description of the grasslands given in the following pages applies to the areas that have been kept free of secondary scrub-growth. Nearly all the common grasses and clovers met with in pastures generally can be found in the Taranaki back-country at the present time in greater or smaller amount, but a great many of these have been introduced slowly and only during the past few years. In the early days of felling and sowing this country little else but rye-grass, cocksfoot,

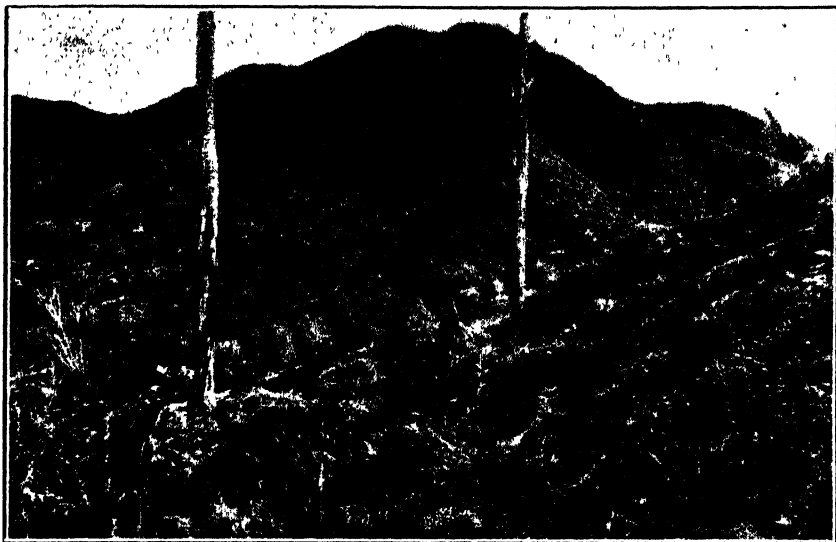


FIG. 32. GENERAL VIEW OF COUNTRY ALMOST ENTIRELY RUN TO SECONDARY GROWTH.

On the easy sloping foothills, in the middle distance, may be noted good grass comparatively free of scrub growth. Higher up, where the bracken has been crushed out, is a zone of hard fern and manuka, and above to the top a mass of bracken-fern.

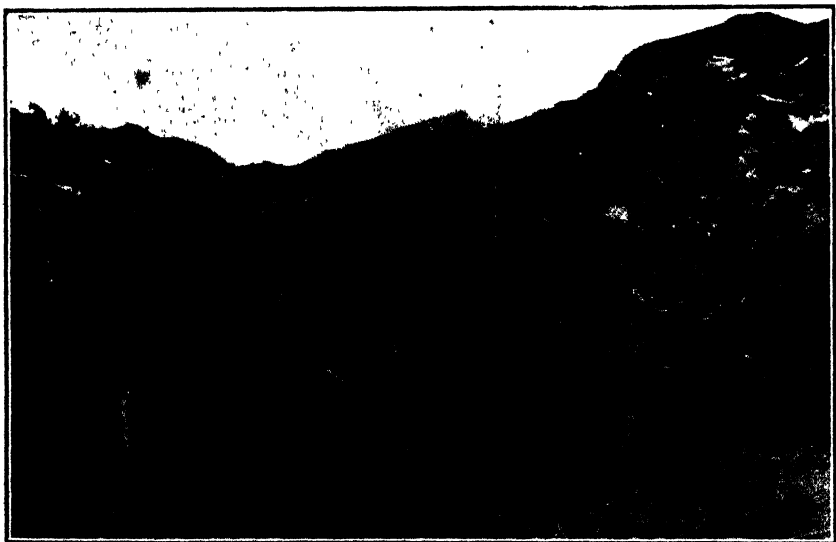


FIG. 33. TYPICAL HILLSIDE OF RATHER WELL FARMED COUNTRY AS REGARDS STOCKING.

On the easier, better grassed portions there is scarcely any hard fern, but on the steeper, poorer faces the patches are almost contiguous.

[Photos by E. Bruce Levy.]

and red and white clover were used. Later sowings included some of the other better grasses such as timothy, crested dogstail, meadow-foxtail, *Poa trivialis*, and *Poa pratensis*; and a sprinkling of these even might have been sown on the very early burns. It is only recently that the farmers of the district have appreciated the need of introducing the second-class grasses—brown-top, *Danthonia pilosa*, &c.; but even yet many still pin their faith to the better English grasses such as cocksfoot and rye-grass. One farmer on being questioned as to what he was sowing on his bush-burn exclaimed, "The old Scotch mixture—a lot of rye with a bit of cocksfoot thrown in"; and in certain recent burns examined by the writer undoubtedly the bulk of the grass-growth is cocksfoot and rye-grass. In his opinion it is largely the lack of the finer close-turf-forming grasses that has led to so much going back of the country to secondary growth.

For the present-day farmer who does not include the finer* grasses in his mixture one can have little sympathy; but the pioneer settlers of the Taranaki back-country cannot in any way be blamed for their omission, for certainly the great forest-growth and the remarkable early productivity of the hill pastures gave indication and promise of a wonderful fertility, so that it appeared then almost criminal even to suggest the poorer, second-class, finer grasses, in view of the so prolific growth of the better English species. The wonderful growth of the clovers also led further to the belief that the Taranaki back-country was eminently suited for the first-class grasses and clovers. The writer claims that this country is still good potential grassland, although the farmer there must needs come to realize that the finer second-class grasses and clovers must be included to take up the running as the better grasses and clovers weaken and go out. Again, the grasses themselves must be considered more and more. In this there are three important aspects to consider with regard to each species: (1) Its growth-form, (2) its soil-fertility requirement, and (3) its response to different methods of utilization of herbage produced—grazing by different classes of stock, haying, burning, &c.

A typical old hill pasture of the Taranaki back-country where such has not gone to secondary growth appears but poorly constituted. In general the sward is open, cocksfoot predominating, but nowhere does this grass under grazed conditions by itself form a close compact turf. Excepting where the "heart" has been grazed out of the pasture the original cocksfoot seeding is holding, although the individual plants are not robust, particularly so where no spelling of the pasture has been done. According to the quality of the soil and treatment of the sward the interspaces between the cocksfoot plants are filled with different classes of growth. On the light open knolls

* This term has come into general use among farmers to indicate the finer-foliage grasses that have been used to fill up, making a fine, compact turf. No doubt the term arose from a consideration of the extremely fine foliage of *Chewings fescue*, which has been used for years in the hill-country pastures. The term is now meant to include such grasses as brown-top, *danthonia*, &c., although these at times are not particularly fine in the foliage. In general, the "finer" grasses are close-turf-forming grasses, and really it is the close-turf-forming attribute rather than the fine foliage that makes these grasses important. Accepting this definition it will be seen that a coarse-foliage grass like *paspalum* may even be included as one of the "finer" grasses.

the cocksfoot is extremely poor, dried out, and stunted, and the interspaces are here usually large and occupied by catsear (Fig. 34). Almost pure associations of catsear may be found on these drier knolls; *Poa pratensis* may also figure somewhat here, but its growth is sparse and open. Certain of these knolls also may be occupied by a dark-brown coloured, short, stiffly erect moss, which precludes almost all other plant-growth. Occasionally in these places, also, other grasses are met with; *Chewings fescue*, and a fine-leaved, sparse vegetative form of *danthonia*—*D. semiannularis* var., more or less peculiar to the district—may be found, and often the initial stages of a *Danthonia pilosa* invasion are being enacted. *Danthonia pilosa* will prove successful against all present occupiers of these knolls as time goes on. In a general hillside pasture of the Taranaki back-country it can be said, however, that such knolls occupy only a small proportion of the area.



FIG. 34. TYPICAL PIECE OF TURF ON POORER ASPECT OF COUNTRY WHERE ONLY COCKSFOOT, RYE-GRASS, AND CLOVERS HAVE BEEN ORIGINALLY SOWN.

The interspaces are here filled largely by catsear. In these places the poorer grasses are essential to the formation of a closed turf.

[Photo by E. Bruce Levy.]

The general surface slope is of a better quality. On these better portions cocksfoot still largely predominates, and the sward again is usually open, bare ground still showing through. Here almost invariably the cocksfoot is associated with *Poa pratensis*, but these two alone do not form on the average slopes a close and continuous sward. In places yarrow assists, and here almost a closed turf is obtained. In many pastures Yorkshire fog is extremely common, and certainly it must be contributing largely to the productivity of the grassland. Yorkshire fog, however, keeps on dying out, and this means again an opening of the pasture sward. Crested dogstail in

certain sowing—particularly so in the old Government sowings made over twenty years ago—is persisting, and on these fair average slopes it is, as one would expect, associating well with the cocksfoot. Odd plants of timothy may persist there too. White clover may often be present associated with the foregoing grasses, but it is not doing well excepting where the pasture is well grazed, tramped, and consolidated by stock. Suckling-clover is common throughout, and odd plants of red clover still persist. The weed content of these average slope pastures is often very high. Catsear, rib-grass, cudweed, creeping buttercup, and selfheal may often be present in large numbers, filling in really between the cocksfoot plants, and occupying that position where companion pasture-plants should be thriving. Goose-grass and hair-grass are regular annual weed-grasses, while sweet vernal is commonly met with and is apparently on the increase in many pastures.

Almost invariably where the pastures have been well tramped, consolidated, and manured by stock there is a dense, close, and continuous turf. Perennial rye-grass in such places still persists and thrives, crested dogstail, *Poa pratensis*, timothy, cocksfoot, and even *Poa trivialis* are all strong and vigorous; white clover grows profusely, associating with the grasses and forming really with the latter some of the finest hill-country grasslands in New Zealand (Fig. 35). Unfortunately, however, the areas of these good pastures is small. They are confined mainly to the holding-paddock, special home paddocks, and areas about gateways, along the ridges and camping-places for stock—anywhere, in fact, where stock by heavy treading and manuring consolidate the soil and maintain these areas in a high state of surface-soil fertility (Fig. 36). The importance of this point in the management of pastures will be considered later.

On heavily stocked areas where pasture plants have never been introduced, or else where they at one time or another have been completely tramped out by stock, there may be a prolific weed-growth mainly of selfheal, greater plantain, creeping buttercup, pennyroyal, or mayweed. *Poa annua* also may be extremely abundant in these places.

Certain other pastures, again, more particularly on the higher country where kamahi was fairly prevalent in the primary forest, may be mentioned—pastures that have been kept well grazed for upwards of twenty years, and where the secondary growth has in one way and another been kept out. Here, associated with the cocksfoot—when the latter has not been entirely eaten out—may be often found a dense sward of New Zealand rice-grass (*Microlaena stipoides*) and danthonia, usually the *D. semiannularis* referred to previously. In other open closely grazed sheep-pastures piri-piri is frequently bad.

On the shady faces the grass turf is often extremely poor; odd cocksfoot-plants still persist, also some crested dogstail, *Poa pratensis*, and Yorkshire fog, but there is often much moss-growth, and indigenous herbs such as nertera (*Nertera Cunninghamii*), pratia (*Pratia angulata*), and pennywort (*Hydrocotyle moschata*) are common. The turf is usually very open, presenting much bare ground. In some other pastures *paspalum* is gaining ground, and in such cases virtually no weed-growth occurs, there being formed a close and continuous turf. In the



FIG 35 TURF OF COCKSFOOT, PERENNIAL RYE-GRASS, TIMOTHY, POA PRATENSIS, AND WHITE CLOVER ON RIDGE USED AS A STOCK TRAIL AND CAMP.

The stock by their treading and dunging have maintained this area up to the standard of fertility demanded by the better grasses, and consequently these are strong and vigorous

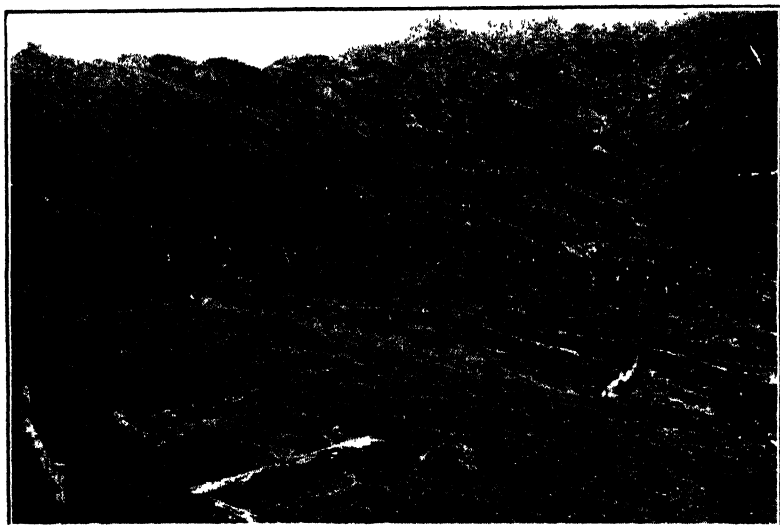


FIG. 36. AREA USED AS A SPECIAL HOME AND HOLDING - Paddock ON FARM OF MR. A. COXHEAD, WHANGAMOMONA.

The turf here is close and continuous, with cocksfoot and white clover dominant—an excellent example of what can be accomplished under consolidation and maintenance of fertility by inbrought stock.

[Photos by E. Bruce Levy.]

more recent sowings brown-top and *Lotus major* have been used, and where turfs containing these two species are met with the weed content is again low and a close and continuous turf is the rule. *Danthonia pilosa*, too, is spreading throughout, particularly so on the drier slopes, and this grass is forming a close even turf virtually free of weeds.

IMPORTANCE OF THE FINER SECOND-CLASS GRASSES.

Of the old hillside pastures of the Taranaki back-country, then, with a few exceptions it may be said that the pastures are poorly constituted. It is not that the soil is lacking in quality so that a close turf cannot be formed, but rather that too few species of grasses and clovers have been included in the original sowings. The soil surface in its virgin state is too light and too unconsolidated for rye-grass to hold, and cocksfoot, unless bound by other companion turf-forming grasses, either goes out entirely or else becomes dried up and stunted. If these two species, therefore, form the bulk of the mixture sown an open pasture will result in a few years. Then it is that the area becomes a prey to weeds. These two grasses certainly are essential in the seed mixtures, but more and more consideration must be given, both in primary and in secondary burns, to the finer grasses and clovers—brown-top, *Lotus major*, and *Danthonia pilosa* being of outstanding importance.

The formation of a closed turf is extremely important, but it is of equal importance that that turf should be constituted by as many suitable pasture species as possible, particularly so at the offset, for if this is so no matter how the pasture is treated subsequently there is bound to be some grass that will thrive under the conditions of management meted out. The great trouble in the past has lain in the constituting of our permanent hill-pastures by species of grasses and clovers that could not persist and thrive there under the severe conditions of close and continuous grazing, and under a state where the surface-soil fertility is being gradually depleted.

SOIL-FERTILITY IN RELATION TO THE VIGOUR OF DIFFERENT PASTURE SPECIES.

The grassland farmer should recognize that every grass and clover that may be used in his pastures has a standard of soil-fertility that must be maintained in order that that species may thrive. This conception, the writer thinks, is of fundamental importance in grassland maintenance. It can be put down fairly definitely that the better first-class grasses such as meadow foxtail, timothy, rye-grass, cocksfoot, &c., demand a higher available soil-fertility than do the poorer second-class grasses, and unless this is maintained these first-class grasses will not thrive and will not produce, under a reduced condition of soil-fertility, as much herbage as will the poorer grasses on that same soil. This fact, of course, is at the root of all succession in our pastures. If the second-class grasses did not thrive better and produce more herbage on these soils than do the first-class grasses there simply would be no replacement of the latter grasses by the former.

If we study certain pastures existing on the different soil-types in New Zealand we find that it is the effort of the farmer to grass soils of varying quality with correspondingly different pasture-species. On

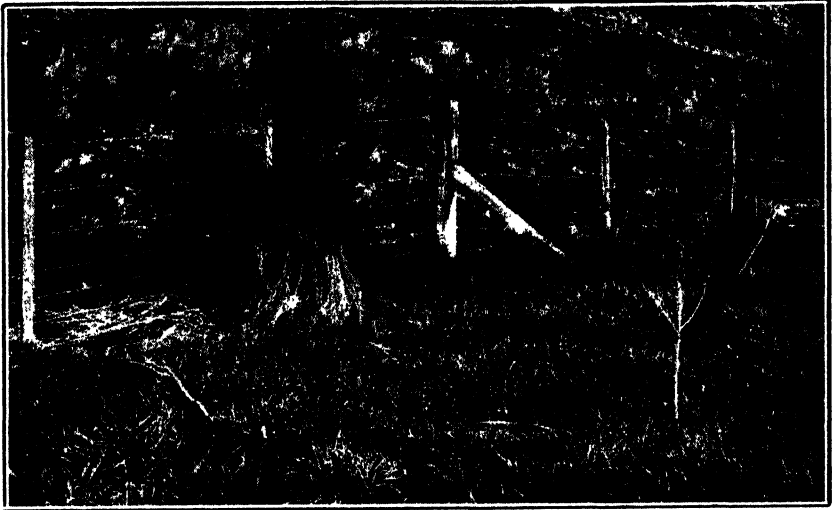


FIG. 37. SHOWING RETURN OF DOMINANCE OF PERENNIAL RYE-GRASS AS A RESULT OF INCREASE IN SOIL-FERTILITY.

The area inside the fence was available as a run-off for sheep from a rape crop growing on the flat. This portion is mainly perennial rye-grass. Outside the fence, with exactly the same turf originally, the fertility is low, and the turf is open, consisting largely of *danthonia*, *Poa pratensis*, and stunted cocksfoot and rye-grass.

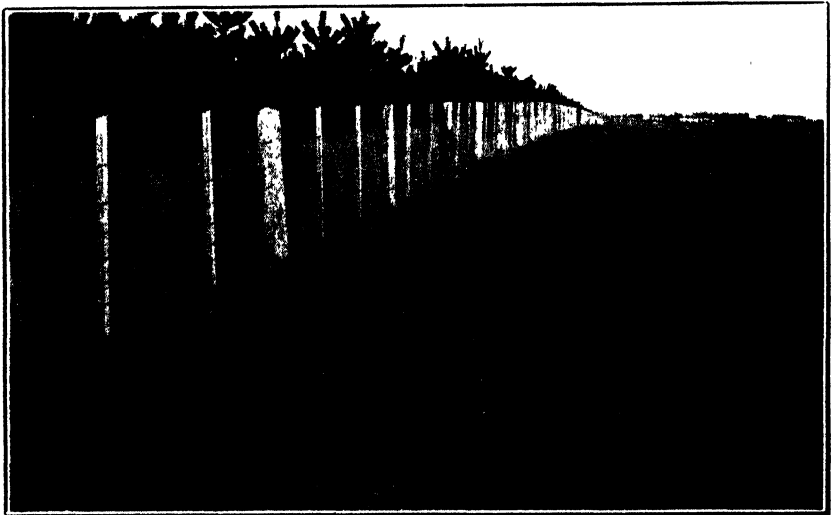


FIG. 38. DOMINANCE OF THE BETTER GRASSES AGAINST POORER ONES UNDER A SYSTEM OF SURFACE-SOIL FERTILITY-MAINTENANCE.

In the paddock (right) is an old sward mainly of cocksfoot, crested dogstail, *Poa pratensis*, and white clover. Here the soil-fertility has been maintained up to the standard of these grasses by top-dressing with artificial manures. Outside the fence (left) is an unbroken mass of brown-top, seeding profusely. While top-dressing is continued there will be no fear of invasion of the turf inside the fence by brown-top. Taken in Southland.

[Photos by E. Bruce Levy.]

the damp, very fertile swamps and alluvial plains the effort is to secure a meadow foxtail - *Poa trivialis* - timothy dominant type of permanent pasture. On soils not quite so damp and fertile perennial rye-grass is almost invariably chosen as the main constituent. On soils just too poor for perennial rye-grass to thrive luxuriantly, cocksfoot, meadow fescue, crested dogtail, and (on the hills) *Poa pratensis* are the species most commonly used. On the poorest soil-types poorer quality grasses than the foregoing are employed. In the laying-down of these soil types to grass it is fairly safe to say that the farmer will choose for each type the highest yielding and the most palatable of grasses and clovers that it is possible for him to get to thrive there. Therefore, on this assumption, the common grasses can be arranged in their order of merit from a yield *plus* quality of herbage point of view.

When this is done it is found that they run somewhat as follows :—Meadow foxtail, *Poa trivialis*, and timothy come first ; perennial rye-grass is a good second ; then follow cocksfoot and meadow-fescue associated with crested dogtail and *Poa pratensis* third ; brown-top is fourth ; *Danthonia pilosa* fifth ; and about the bottom of the list come *Danthonia semiannularis* and Chewings fescue. Again, if these groups are examined it is found that the topmost group in the list requires the highest state of soil-fertility, and as we descend so grasses are found that can persist and thrive under poorer and still poorer conditions of soil-fertility.

The important point is that if we have soil up to the standard of fertility required by, say, perennial rye-grass that grass will persist and thrive, and so great will be its growth that none of the poorer grasses below it in the list will have a chance of competing with it (Fig. 37).^{*} Consequently it is found that just so long as the first-class grasses are doing well there is under reasonable conditions of grazing no fear of invasion of that soil by the inferior grasses (Fig. 38). The increasing presence of the poorer grasses in a pasture most certainly indicates that the better grasses sown are weakening and are going out. On a well-farmed hill-pasture it will be found that the poorer species predominate on the drier knolls, which are below the standard of fertility demanded by the first-class grasses. In the damper and richer hollows, on stock camps, &c., the poorer species are scarcely represented at all. Cocksfoot can persist and thrive on soils lower in fertility than will maintain perennial rye-grass, and its persistence against the latter on many of the lighter soils of Taranaki is due largely to the fact that perennial rye-grass demands a state of soil-fertility higher than that prevailing in general throughout these lands.

Certain grasses have a longer range of adaptability to a soil gradually becoming depleted in available surface-fertility than others. Thus meadow foxtail, *Poa trivialis*, and timothy have quite a short range, and simply will not thrive on poor soils. Cocksfoot has a fairly long range, although its productivity falls off considerably on the poorer soils. Grasses such as *paspalum* and Yorkshire fog have an extremely long range, in each case the yield being proportional to the fertility of the soil. Even on the poor soils, however, *paspalum* will in a warm district produce more feed than will the poorer grasses that are at home

^{*} Compare also Figs. 50 and 51, p. 47, Bulletin No. 107, "The Grasslands of New Zealand : Series I. Principles of Pasture-establishment."



FIG. 39. *DANTHONIA PILOSA* (FINE FOLIAGE ON RIGHT) AND COCKSFOOT (ON LEFT) GROWING TOGETHER ON RATHER A POOR KNOLL.

Danthonia is here easily beating the cocksfoot in yield, the soil suiting it and being below the standard of fertility demanded by cocksfoot

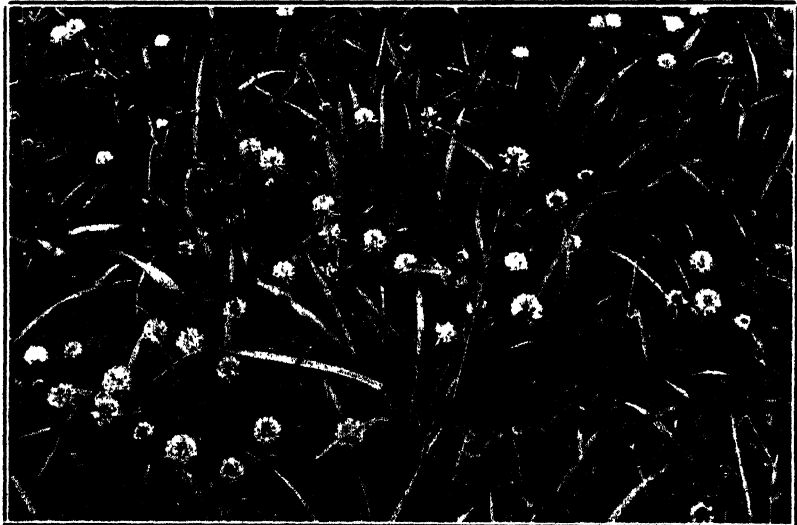


FIG. 40. SOIL MAINTAINED UP TO THE STANDARD OF FERTILITY OF COCKSFOOT AND WHITE CLOVER ON LIGHT LAND.

The sward previously was open, the cocksfoot stunted, and the white clover scarcely in evidence. As soon as the standard of fertility was raised (in this case by artificial manures) the cocksfoot and white clovers came away rapidly, filling up all bare spaces and securing dominance over weeds.

[Photos by E. Bruce Levy.]

there, but in general this is not true of other grasses. They may persist on the poorer soils in an extremely stunted condition, but their yield there is virtually nil, and consequently the second-class grasses beat them in production (Fig. 39).

In the Taranaki back-country the original fertility of the forest burn was up to the rye-grass and cocksfoot standards, but as the fertility lowered the rye-grass dwindled and the cocksfoot became the dominant element of the pastures. After ten years or so, however, with constant grazing and removal of wool or fat stock from off that area the fertility of much of the hill country became reduced below the standard demanded by cocksfoot, and then this grass also began to wane and weaken and to go out. In most of the original sowings, unfortunately, there were not included grasses which could thrive on soils below the cocksfoot standard of fertility, and thus the pastures became open and ran into weeds. Brown-top demands a standard of soil-fertility between cocksfoot, on the one hand, and *Danthonia pilosa* on the other. If brown-top and *Danthonia pilosa* had been added to the mixtures sown the brown-top would have taken up the running on the better soils, and on the country a little too poor for brown-top *Danthonia pilosa* would have come in. The writer does not think that in the Taranaki back-country any system of grazing could reduce the soil-fertility below that demanded by *Danthonia pilosa*, and therefore if the latter could only get established throughout the hill country a sward of grass would be virtually assured there for all time. To the writer's mind the possibilities of that country are such as to give promise that better-yielding grasses than *Danthonia pilosa* can be maintained under a sound system of management, but the *danthonia* is necessary, for there are always poor spots, dry knolls, &c., that no economic system of farming could bring up to a state of fertility such that the better grasses would yield there higher than *Danthonia pilosa*. This conception of each grass for its own special habitat defined in terms of soil-fertility is important. The physical nature of the soil, apart from its fertility, the growth-form of the plant, and its response to different methods of grazing, however, are also important and should not be lost sight of.

THE BETTER GRASSES UNDER A REDUCED SOIL-FERTILITY AND THE SECOND-CLASS GRASSES AS PIONEERS.

There is another equally important and fruitful conception in relation to grassland mixtures. If one examines carefully pastures formed even of the poorest grasses, provided there has been a good mixture sown, there will often be found the better grasses—stunted and mere vestiges of their former selves, but yet alive. While there is life in these better species there is hope for the improvement of that pasture, and if the farmer sets to work and raises the standard of fertility of that soil he will find that the better grasses again assert themselves and soon begin to replace the poorer species. This is true only if the better species have been sown and are still alive (Fig. 40). On this argument, however, it might be contended that if it is possible to bring back the first-class grasses it would be better to use only these grasses and keep them going by maintaining the surface fertility. On most ploughable country, of course, this could be done. But there



FIG 41. LOTUS MAJOR STRUGGLING AGAINST HARD FERN AT WHANGAMOMONA.

Typifying one of the essential plant-forms that must be included in mixtures where there is a struggle against tall aggressive weeds. Sufficient growth has been here produced among the hard fern to entice stock to work on to the patches, and when this can be done the hard fern will be gradually ousted.



FIG. 42. PASPALUM INVASION OF HARD FERN IN THE NORTH AUCKLAND DISTRICT.

Exactly the same object is attained here as in the case of the Lotus major in Fig. 41. Stock are induced to graze among and to tread on the hard-fern patches.

[Photos by E. Bruce Levy.

are certain types of country that have to go through a breaking-in phase, as it were, and in order to tide over this phase, which may be one of consolidation or one of weed-suppression, it is often necessary to include in the mixtures poorer grasses that will function while this is being effected. On certain light pumice soils, for example, where consolidation is an important factor, poorer grasses than those one would like to see used there must be included in the original permanent-pasture mixture. It is futile to strive to get a sward of the better grasses to hold on these soils while in an unconsolidated state. Certain of the poorer grasses will hold and form a sward with some plants of the better elements persisting in a mere vestigial condition. When the sward is formed the surface may become consolidated by stock, and then with artificial manures, &c., the fertility may be raised up to the standard of the better grasses. In many cases, therefore, even on ploughable country, the poorer grasses are needed to form a sward so that stock may be held there to effect the consolidation; and then by improvement in surface-soil fertility we may get back to the better grasses. The poorer grasses give a foundation to build upon; without them the better grasses would go out and the pasture would then run to weeds.

In the Taranaki back-country we have a similar breaking-in phase; not only is lack of consolidation an important factor, but there is also the great struggle against secondary growth. If only the hill country of Taranaki could be consolidated all the easier country at least could be brought back to the cocksfoot - crested dogstail - white clover - *Lotus major*, and even rye-grass type of pasture, a fact amply demonstrated on any stock trail, stock camp, or holding-paddock (Fig. 36). In order to effect this consolidation and to fight against secondary growth poorer elements than one would like to see must be employed—elements, in fact, that will hold under a loose-soil condition; and ones that will endure for some time the shade of the secondary growth, yielding there some feed that will entice stock into such growth (Figs. 41 and 42); or that will carry a fire at a later period. The consolidation of the soil is a slow process where stock alone is the implement of consolidation that the farmer can use. And unless a turf is secured on the virgin loose soils it is not possible to effect any improvement along the lines of consolidation, because the secondary growth will force the stock off the area. Once the soil surface is well grassed, however, it is possible with this as a foundation to proceed to improve the soil-fertility, raising it gradually up to the standard of the first-class grasses. Here, then, can be seen the necessity of sowing along with the brown-top, &c., some seed of these better grasses. The important thing is to have a good mixture of grasses and clover that cover a wide range of soils, as far as their adaptability to soils of varying fertility is concerned. The more uneven the hill country and the more variable the farm management the greater is the need of a big range of adaptability in the mixtures of grasses that are sown.

In future articles of this series it is intended to deal with the individual species of grasses and clovers, and to endeavour with our present knowledge to indicate which species are likely to prove the best and how each will play its part in the process of winning the country now under consideration back to good grassland.

(To be continued.)

THE BUSH-SICKNESS INVESTIGATION.*

LABORATORY WORK AND RESULTS.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

I. INTRODUCTION.

IN the following pages it is hoped to throw some light on the obscure malnutrition trouble in domestic ruminants known as "bush sickness" by recording the results of laboratory work; but it is first desired to prepare the reader by a general statement of the case as it appears to a chemist, which will be followed by the recital of the details of laboratory experiments and end with a summary of conclusions and suggestions for future work.

It must be accepted that in the early stages of the investigation, which was begun about 1898, the veterinary pathologists fully satisfied themselves that the trouble was neither contagious nor infectious, and that no pathogenic organism could be detected or isolated, nor could the presence of any such organism be inferred by transfusion experiments of blood from unhealthy to healthy stock. Further extraordinary circumstances incidental to bush sickness ascertained were the confinement of the disease over long periods of time to one special area, where it invariably appears in all cattle and sheep if pastured long enough in that area, the rapidity with which such stock recover after removal from that area, and the absence of any acquired immunity.

From many opinions it will be sufficient here to quote Mr. H. A. Reid, Officer in Charge of the Department's Veterinary Laboratory, Wallaceville, who stated, after a long experience with bush sickness and with those veterinarians who came more immediately into contact with bush sickness in the field, "It is not a disease in the ordinary sense of the term, but a state of malnutrition resulting from some hitherto unascertained cause. All attempts to artificially infect animals with products from pre-existing cases have consequently failed, and the elucidation of the problem has resolved itself more into a question for the physiological chemist than the veterinarian." ("Diseases of Farm Animals," 1923, p. 481.) This may be taken as the official veterinarian attitude, arrived at after years of field-work and observation by a number of professional and stock officers, and it clears the ground considerably for the chemist. The latter, however, has always been handicapped by having his laboratory some four hundred miles from the bush-sick area. The difficulties introduced by this geographical limitation will become sufficiently obvious as this narrative proceeds.

DIAGNOSIS AND SYMPTOMS.

There can be no doubt that the ailment has been correctly diagnosed as progressive anæmia. Thus Dr. J. A. Gilruth reported that his observations showed there was in the later stages a very decided anæmia.

* See also "Bush-sickness Investigation: Five Years' Work at the Mamaku Demonstration Farm," in last month's *Journal*.

The symptoms of bush sickness are accurately described by Reid (*l.c.*, p. 481) as follows:—

The symptoms of "bush sickness" in both sheep and cattle are similar. They appear within five months to a year after depasturing stock on affected country—sheep showing signs of disordered health earlier than cattle.

The earliest evidence of the complaint is seen in the general aspect of the animal, its condition appearing poor in relation to the abundance of feed to which it has access. Soon afterwards a pronounced unthrifty appearance sets in. The wool of sheep becomes lustreless, dry, and harsh to the touch, while it has a tendency to loose its natural curl and to stand up like hair on the body.

In cattle much the same train of symptoms takes place. The animals look "tucked up" in the flank, coat dull and staring, and a general haggard appearance takes the place of the sleek condition which the animal should possess in response to the amount of apparently good feed which is being consumed. The further stages are those of progressive loss of condition, and gradually increasing weakness. The animals are easily approached. Sheep become too weak to escape, and are readily captured. Finally the victims of this malady lie down and die of starvation amidst plenty. It is not uncommon to find young beasts, emaciated and weak, dying in a luxuriant clover-paddock.

An additional symptom not mentioned is the running at the eyes in sheep.

Post mortem examinations of animals suffering from bush sickness have been frequently made. Gilruth noted a fatty infiltration of the liver, which later and wider experience has proved to be always present in typical cases. Later Dr. C. J. Reakes, who succeeded Dr. Gilruth in the active direction of the investigation and entered into the work with painstaking care, stated that in a series of *post mortem* examinations there was, apart from the extreme emaciation characteristic of bush sickness in its last stages, only a marked fatty infiltration of the liver, and a very slight gastric catarrh and very slight catarrhal nephritis, the last mentioned being only detected on microscopic examination of tissue sections. Clotting of the blood was very rapid after it had been removed from the animal. Gastric, intestinal, and bronchial parasites were usually absent and never present in quantity. No blood parasites could be detected. Blood counts showed some diminution in the number of red corpuscles, and the hæmoglobin test demonstrated a well-marked deficiency in hæmoglobin, a result which chemical analysis of the blood of diseased animals has borne out.

HYPOTHESES AS TO CAUSE.

There have been several hypotheses advanced from time to time as the cause of bush sickness: (1) A deficiency of some important constituent in the food-supply; (2) the presence of some mineral poison, or possibly some organic poison in the food-supply; (3) a want of proper balance in the food constituents; (4) a deficient or poisonous water-supply.

First of all it is desirable that the drinking-water should be eliminated as a suspected cause, and this can be done with perfect assurance. The writer is in complete accord with the statement that the water-supply has no immediate bearing on the disease. Where animals keep healthy on land containing springs, whereas on nearby land containing no springs they develop bush sickness, the true solution of the discrepancy is no doubt that the former land differs in some essential from the latter, and that the production of springs in the first case is an adventitious result due to some difference in the mode of formation of

the land or of its situation. Chemical analyses and experiments on animals reveal no reason why the composition of the natural or artificially stored waters of the country should be suspected of having the slightest influence on the incidence of the disease.

With the elimination of the drinking-water one is naturally restricted to a consideration of the food as the cause of bush sickness, and must be confined to a consideration of the first three suggested causes. As all food consumed, however, is grown on the spot it will be as well if the inquiry is first directed to a consideration of the soil which grows the food, and to this end some space will be devoted to a study of the highly abnormal kind of soil upon which the pasture is grown which produces the condition in stock without precedent in other countries.

The soil of the bush-sick area is certainly highly abnormal in origin, character, and situation. It is a soil unprecedented in its environment, and hence one may expect little help from a study of pumice soils in other countries. One would have to look for a similar soil put to similar uses in a similar climate in order to derive any assistance from the practice of other countries. So far the writer has not been able to learn of any area in any other part of the world which corresponds to the bush-sick area.

Soils are almost invariably formed by the weathering and disintegration of rock, a slow and gradual process whereby much of some of the original constituents of the rock is dissolved out and washed away in the drainage-water. The soils of this "sick" country, on the contrary, have not been weathered to the same extent. They are invariably soils consisting largely of pumice and other ejectamenta comparatively recently blown out of the bowels of the earth, and scattered by the wind over a large area of country. Pumice is an acidic lava (containing a large excess of silica or silicic acid) which has been frothed up when in the molten state, and so intimately mixed with the gases of the volcano that the apparent specific gravity of the rock is very much lessened; owing to the entangled gases the solidified pumice is enabled to float on water, or to be wafted considerable distances by air-currents. It is a well-known fact that recently ejected volcanic ash will not grow crops until the sulphides, which are poisonous to the plants, have been oxidized into harmless sulphates. It is possible that pumice will not grow animals for some similar reason.

We have thus two very distinct points of dissimilarity between bush-sick pumice soils and ordinary soils. The bush-sick soils have been deposited from air (not water), and the particles had not at the time of deposition been weathered or decomposed. There is much pumice soil which has been weathered and deposited by running or lake water, and which exists in the form of terraces. To these areas the stigma of bush sickness does not apply, and it is open for a topographical and soil survey to demonstrate that pumice soils formed in a normal manner are free from bush sickness. As an example one might instance the lands surrounding the Town of Rotorua, which are free from bush sickness although composed mainly of pumice. Most soils within this great crater, however, have been laid down by water mainly. This is shown by the terraces which exist on all sides of the lake.* This Lake of Rotorua was very much higher than it now

* Some of the higher terraces in the Rotorua crater may have been overlain by aerial deposits subsequent to the rapid lowering of the lake-level.

is—possibly some hundreds of feet above its present level. The waters no doubt subsided quickly at first, as they did at Lake Tarawera after the 1886 eruption; afterwards the sinking of the lake-level was more gradual, allowing aquatic and moisture-loving plants to grow readily and form humus as the terraces were formed, and this gradual sinking is still going on. Thus two great agencies are at work on the pumice in the Rotorua basin—compaction by pressure, and weathering by water and dissolved gases assisted by humus. These treatments are no doubt the most valuable which may be applied to the light soils of the volcanic plateau. In farming practice they are represented by rolling and by supplying humus, but all the rolling possible in farm practice will not equal the pressure which has been applied by hundreds of feet of water upon every acre.

The writer does not intend to quote figures in this introductory article, but it may be here said that the pumice soils yield only, by the ordinary laboratory methods of attack, exceptional results in the mechanical analysis designed to disclose the texture of the soil. It is found that the texture is extremely coarse—a feature which is mitigated by the abundant and well-distributed rainfall.

SOME DISCARDED HYPOTHESES.

When samples were first obtained for chemical analysis from the bush-sick area, in 1901, the outstanding chemical result shown by the cocksfoot-grass from unhealthy country was the small amount of phosphoric acid present compared with the amount found in grass growing on normal healthy country. The soils themselves did not show any great deficiency of phosphate, although they were not well supplied with this essential plant-food. The possibility of phosphate deficiency being the sole cause of bush sickness was early recognized, and thoroughly tested by top-dressing old pasture with an excessive application of superphosphate (7 cwt. per acre), and pasturing steers on the treated pasture. Although these beasts remained healthy for about twelve months after the animals on the adjoining untreated pasture had died of bush sickness, the animals on the treated pasture eventually fell sick also and had to be removed. Thus, although top-dressing grass with phosphate lengthens the time during which stock may be kept healthy from six months to two years, phosphate treatment cannot be relied upon to keep stock permanently healthy. Moreover, animals store up in various parts of the body inorganic or mineral foods which are assimilated in excess of the immediate requirements of the body. Thus iron is stored up in the liver, spleen, and bone-marrow. Phosphates are deposited in the bony tissues of the body. When the supply of any mineral food cannot be assimilated from or falls short in the food the animal may draw upon its stored up reservoir of mineral food.

In the case of phosphates being deficient in the food-supply one would expect that the bones would be the first to suffer and to show signs of weakness. The bones contain a far greater percentage of phosphate than any other part of the body. In some parts of New Zealand there develops in ruminants a bone-disease known as "Waihi disease" in cattle, and osseous cachexia and osteomalacia in sheep. This bone-disease yields at once to treatment of the pasture by top-dressing with phosphate or by drenching the animal with a medicinal

phosphate. It seems fairly well proved, then, that in such cases the animal is unable to obtain enough phosphates from the food, and that when it is supplied, either in the food or as medicine, the animal recovers. If, therefore, the deficiency of phosphate were the sole cause of bush sickness one would expect that the bones of stock dying from that disease would be unusually fragile or abnormal in external character and chemical composition. The contrary is the case. The bones have been proved to be normally strong and of the usual composition. Bone-disease in cattle has, however, recently occurred in a pumice area, and has yielded to the same treatment that would be applied if it had occurred on any other type of soil.

When unmixed with decaying vegetation or humus, pumice soils are often very low in phosphoric acid, but when a pumice soil has grown forest the action of life results in bringing phosphates to the surface—the result of the continuous fall and decay of leaves, branches, fruits, and flowers. It seems a provision of nature that life on land results in the accumulation at the earth's surface of phosphates, thereby enabling the plant and animal population to become increasingly denser. Phosphate, as is well known, cannot be washed out of the soil to any extent by the drainage-water. The hypothesis that phosphate deficiency is the single cause of bush sickness was thus early examined and discarded.

Another highly abnormal occurrence in the pumice country is the relatively large amount of silica in the dissolved solids of the surface waters, springs, and wells. Usually in natural waters silica is quite a minor constituent, but in the waters of a large area of the North Island Plateau and Upper Waikato Basin silica is the principal solid constituent. Although small in absolute amount it is relative to the other solid constituents—lime, magnesia, soda, and potash—large in amount. This abnormality was considered important enough to investigate. An experiment was, therefore carried out for some time at the Wallaceville Laboratory with the object of determining whether an excess of soluble silica was injurious. The result was entirely negative—no injurious effect could be produced on a calf by prolonged feeding with a soluble silicate. This result was not unexpected. When it is considered what large amounts of silica must be ingested by the animal in the grass it eats each day it is difficult to imagine that a few more grams of silica would prove injurious.

The possibility of an excess of potash being responsible was also investigated, but no evidence could be obtained to show either that potash was present in the natural fodder in excessive amount or that, if so present, it could give rise to the symptoms characteristic of bush sickness.

Salt, which is supposed to assist the animal in the elimination of the large quantities of potash which are daily consumed by grazing-animals, is always supplied to animals on the Mamaku Demonstration Farm, and they avail themselves freely of such opportunity of obtaining it. The administration of salt as a lick is evidently beneficial to both sheep and cattle on bush-sick country, but although it may extend the time animals may be kept healthy its absence as a lick cannot be considered as a cause of bush sickness.

In the next article it is proposed to deal further with the theoretical aspects of the problem.

(To be continued.)

TICKS ON CATTLE AND OTHER STOCK.

THE NORTH AUCKLAND INVESTIGATION.

J. G. MYERS, Biological Laboratory, Wellington.

THERE have now been completed over a year's observations on the cattle-tick, *Haemaphysalis bispinosa* Neumann, in the North Auckland district. The results are embodied in a detailed and lengthy report which it is hoped will be published later. For the more immediate information of farmers the summary which forms the basis of the present article has been prepared. In this *Journal* for August, 1923, the writer presented a preliminary report on the progress of the investigation, and dealt with the main facts of life-history and host relationships so far as they had then been ascertained. Most of the matter given below is supplementary to the previous article, but where conflicting statements occur this is an indication that subsequent work has forced a revision of previous conclusions.

LIFE-HISTORY : FURTHER NOTES.

The average number of eggs laid by *H. bispinosa* is about a thousand. Compared with the performances of many exotic ticks this is quite low. Quite closely related ticks in other countries have been known to lay as many as ten thousand eggs.

When the fully engorged female drops from the host and seeks shelter on the ground, a certain period elapses before she commences to lay. This resting-time is at least a week, but it varies greatly according to the temperature. Thus in March it may be a fortnight, while in late winter to spring the female may remain nearly nine weeks before beginning to lay. Such dependence on seasonal and climatic conditions is of great importance from the viewpoint of control. It is believed that owing to the wet winter and late spring of 1923 in the North Auckland district the tick was considerably later in appearing and in reaching its maximum of abundance in the various stages than in previous years. Since the main and only large infestation by adults occurs about midsummer, at which time the hot weather reduces the pre-oviposition period to its lowest term, seven or eight days may be taken for all practical purposes as the normal time.

The male has been found, throughout the investigation, to be so excessively rare that it is extremely probable that the female ticks are parthenogenetic, or possessed of the very convenient power of laying fertile eggs without the intervention of a male. A considerable number of unfed females were collected by sweeping from the grass where they awaited hosts, and placed in a bag on the scrotum of a bull. No males were present on the scrotum, nor was it likely that they could enter the bag even if they were present in the vicinity. Yet of the three engorged females which were recovered in this experiment two laid fertile eggs. This, of course, is by no means a definite proof that the tick is parthenogenetic, but, taken in conjunction with the

great scarcity of males, it is held to indicate a strong probability. It is most unlikely that pairing takes place off the host. Certain ticks in other countries, of which particulars are given in the full report, have been conclusively shown to be parthenogenetic.

With regard to the hatching of the eggs, experiment shows that there is a steady advance in the time taken by the eggs to hatch as early autumn passes into winter—a long hatching-period in early spring and a much shorter one as soon as the weather becomes hot. Thus eggs laid in the middle of March remained thirteen weeks before hatching, while some deposited at the end of November produced seed-ticks in a little over five weeks. So here again is seen a very strict dependence of the life processes on seasonal conditions.

Larvæ and nymphs stay on the host about six days each, and adults about seven, under late summer conditions. All this time they suck blood. The development from larva or seed-tick to nymph or first eight-legged stage requires about three weeks, and that from nymph to adult four weeks under late summer conditions.

ETHOLOGY.

Under this title have been grouped such observations on various aspects of the habits and behaviour of the cattle-tick as could not legitimately be treated in any of the other sections. Such matters as the distance a tick crawls when it has dropped from the host, the nature of the shelter it prefers—whether moist or dry, cool or warm, light or dark—the manner in which it finds its host—are all amenable to strict scientific treatment, are all of great interest in themselves and most important, and are all of the greatest importance from the standpoint of control. The results of lengthy but perhaps not intrinsically interesting experiments are here summarized.

In *H. bispinosa* we find the extraordinary condition, by no means unique among ticks, that the creature is apparently lacking organs of sight, hearing, and taste. The general skin-surface is probably diffusely sensitive to light, but otherwise the tick, which crawls apparently at random to await a host at the top of the herbage, is completely blind. Nor has it hearing to assist it in its search. But the two legs of the first pair, which are seen to be frequently used in a feeler-like manner, possess not only probably keen sense of touch, but bear also each a tiny vesicle known as Haller's organ and functioning as the organ of smell. The tick, then, gains nearly all its knowledge of the outside world by touch and smell.

The fully engorged female is definitely negatively phototropic; in other words, it invariably seeks darkness rather than light, and freedom from the latter is therefore an essential feature of the shelter it seeks while preparing to lay its eggs.

There appears to be an optimum condition of moisture for ticks seeking shelter off the host. Under too wet conditions ticks crawl away from moisture, while in too dry surroundings they are attracted by water. In experiments arranged to show these characters it is, of course, essential to eliminate all subsidiary factors.

It is interesting to note that waiting unfed seed-ticks may be as plentiful on grass-tops at night as in the daytime.

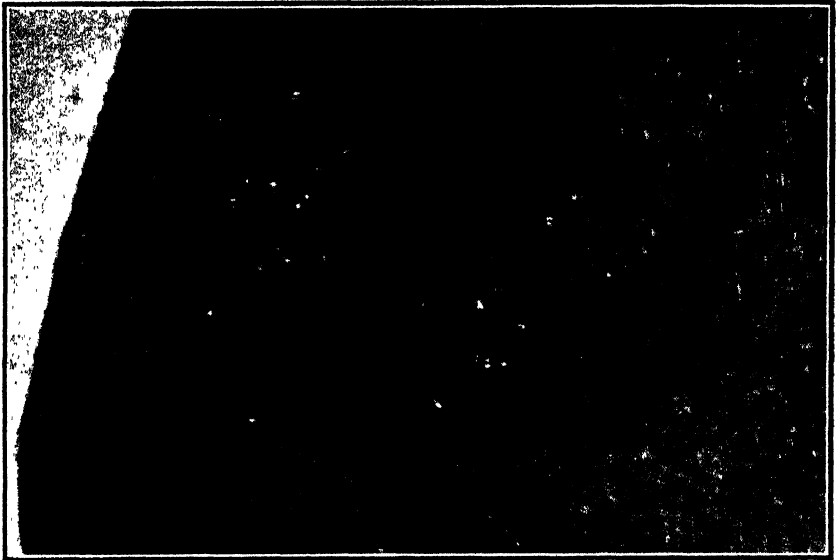


FIG. 1. NYMPH TICKS ON HORSE'S NOSE IN VARIOUS STAGES OF ENGORGEMENT.



FIG. 2. VERY YOUNG HARE INFESTED WITH NYMPH TICKS.

(Photos by the writer.)

The longest period for which this cattle-tick has survived without food (under the most favourable artificial conditions possible) is nine months. In nature such longevity would be almost impossible. As might be expected from the fact that nymphs are the wintering stage, it was ticks in this stage which made the record—a record, by the way, which has been very badly beaten by several species of exotic ticks.

SEASONAL LIFE-CYCLE.

The three main facts which emerge from a consideration of the data collected on this subject are, firstly, that in the late winter and early spring there is a heavy and practically pure infestation of nymphs; secondly, that in late summer and autumn there is an almost equally pure infestation of seed-ticks; and, thirdly, that the adult infestation is at its height at midsummer. Previous work on this subject was led astray by the occurrence of an appreciable infestation of adult ticks in August–September. These adults have now been proved to be overwintered stragglers, the progeny of which, delayed in hatching by the cold weather of early spring, go merely to swell the ranks of the one big larval infestation in late summer. For all practical purposes the course of the seasonal cycle may be described as follows: Eggs are laid by the summer adults, and these produce a large seed-tick infestation in late summer and autumn. Towards the end of this period the engorged larvæ drop from their hosts and seek shelter on the ground, where they cast their skins and emerge as unfed nymphs. These nymphs secrete themselves, preferably at the bases of the clumps of rushes or wiwi which form almost the only shelter in winter when the grass is eaten short, and remain there till July, when they swarm up the herbage and attack their hosts in such numbers as to form a heavy and very pure nymph-infestation. When these have fed to repletion they seek shelter on the ground once more in order to pass through their final metamorphosis into adult ticks. But as the weather at this season is still wet and fairly cold the process is drawn out until well into November, when the great adult infestation commences. There is thus only one brood per year.

HOST RELATIONSHIPS.

There are in the North Auckland district seventeen species of wild and domestic mammals. Of these no fewer than ten act on occasion as hosts of the cattle-tick, a role which is played also, though to a practically negligible extent, by some seven species of introduced and domestic birds.

Cattle, of course, are the chief farm-stock infested by this tick, but horses (particularly by the immature stages—*i.e.*, seed-ticks and nymphs) and hares are also heavily attacked. One very young hare, kindly brought to the writer by Mr. E. Fitzgerald in September, had no fewer than 155 nymph ticks about its head, nor was this the whole of the infestation, since some ticks escaped the counting.

It was at one time supposed that sheep were not appreciably attacked, and it was therefore not until 1923 that they were placed on the list of stock to be dipped for cattle-tick. Sheep were examined in a heavily infested tick district in Hokianga at the height of the adult

infestation. The majority were not heavily infested, though some had a fair number of unfed adults on the ears, axillary regions, and brisket. One ewe, an unshorn straggler, was considered by farmers present and by Stock Inspector C. F. Jacobs, of Kohukohu, to be as thickly infested by cattle-tick as a sheep ever is, except that in this case excessive numbers were not present on the legs. On this ewe ticks were very plentiful on the brisket, where the wool was worn short by lying down, and they had penetrated from here into the wool of the neck, which was largely filthy with tick excreta. Most of the ticks in the wool, however, were dead, particularly engorged or partly engorged ones, though dead unfed ones also were quite common. The number of live ticks in the wool decreased with the stage of repletion, showing that, even when they had been able to crawl into the wool, engorgement often prevented exit. No direct evidence has yet come to the writer that sheep are ever infested over the general body-surface, nor is it thought in the least probable that such will ever occur, except possibly in sheep immediately after shearing, when the wool is so short as to offer but little impediment to the tick.

It is a common occurrence for unfed stages of the tick to climb from the grass on to a person. Apparently only a small proportion of these achieve attachment, but cases are not rare of engorged adults being found attached beneath the clothes. However, none of the stages of the tick can be considered a pest of any consequence to adult human beings. But to children the larvæ and nymphs, and to a less extent the adults, are a real nuisance. Very small children become infested when playing in the long grass, and the ticks are not discovered until they have caused considerable and often serious irritation.

In view of the possibilities of extended carriage by bird hosts the study of these becomes of great importance; but it should be stated at the outset that *H. bispinosa* seems to be pre-eminently a mammalian host tick, and its infestation of birds apparently slight and accidental. Such birds as frequent ticky paddocks can presumably hardly escape infestation, but birds are not suitable hosts, especially for the adult ticks. It is almost essential that the parasites should find a position of attachment reasonably beyond the reach of the bird's beak; consequently the majority of ticks on bird hosts are collected about the head. The belief that kiwis and seagulls carry ticks is apparently founded entirely on confusion with the bird-ticks of the genus *Ixodes*, which superficially resemble the cattle-tick but are adapted for living entirely on birds. No cattle-ticks have ever been recorded from the birds in question, nor from any other native bird. Altogether it appears obvious from the data available as to the relation of birds to the cattle-tick that their value as tick-destroyers immeasurably counter-balances their damage as tick-carriers.

The cattle-tick seems to exhibit a strong preference for hosts (cattle) with a dry scurfy skin due to defective secretion of the sebaceous glands. Consequently susceptibility to tick-attack may in certain cases be more or less hereditary, or due to lack of condition.

NATURAL CONTROL.

Like most other organisms, the cattle-tick is prevented by natural means from increasing to an enormous extent. Of climatic factors

dry heat is probably the most severe in its effects on ticks, especially when the latter are off the host. A plant stands any amount of sun provided it is well watered, but cut leaves wilt immediately. In the same way, when engorged ticks have once dropped, a little exposure to direct sun will kill them. The eggs are similarly susceptible. Excessive moisture also appears to be inimical to the tick.

The chief natural enemies are birds, and of these the most important is the English starling. One farm was examined on which practically

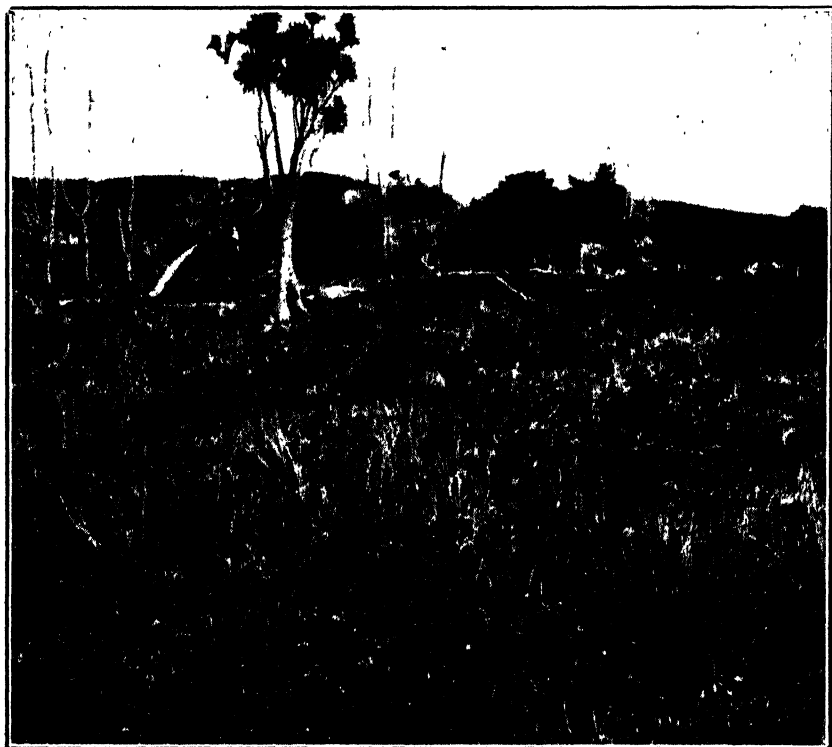


FIG. 3. BADLY TICK-INFESTED PADDOCK OF PASPALUM AND RUSHES.

The rushes in the foreground are in moister ground and sheltered very few wintering nymph ticks. The rushes near the cabbage-tree are on drier ground and sheltered numerous ticks.

[Photo by the writer.]

complete control of ticks had been effected by starlings alone. This farm has been exempted from other control-measures for a time sufficient to study exactly the good which starlings are doing.

It has been suggested that African oxpeckers be introduced, but these birds have been shown to be injurious to the cattle. Moreover, it is probable that the starlings unaided will do the work quite as well as any others that might be imported.

ARTIFICIAL CONTROL.

The most detailed knowledge of its biology is necessary for the elaboration of successful eradictory measures against the cattle-tick. Dipping, spraying, hand-picking, and dressing are all in operation more or less extensively in the tick area, and all are doing a certain amount of good. Prolonged immersion in sea-water is strongly believed in the North to cause the dropping of ticks from the host. This has been found by direct experiments to be only partially successful, and, moreover, to be only very infrequently easily practicable.

The burning of herbage harbouring ticks, especially during late autumn and winter, is most valuable as a means of wholesale destruction, but it presents considerable difficulties, since *paspalum* (of which North Auckland pastures are so largely formed) remains green till autumn and is very hard to burn. A modification of farm practice in the direction of keeping the grass eaten to a turf and eliminating rushes would destroy the greater part of the shelter of ticks off the host, and would probably do more towards their final extermination than any other means at present recorded.

DISTRIBUTION.

The headquarters of *H. bispinosa* are in the Oriental region, particularly in India. The headquarters of this tick in New Zealand is the North Auckland Peninsula, which corresponds to the North

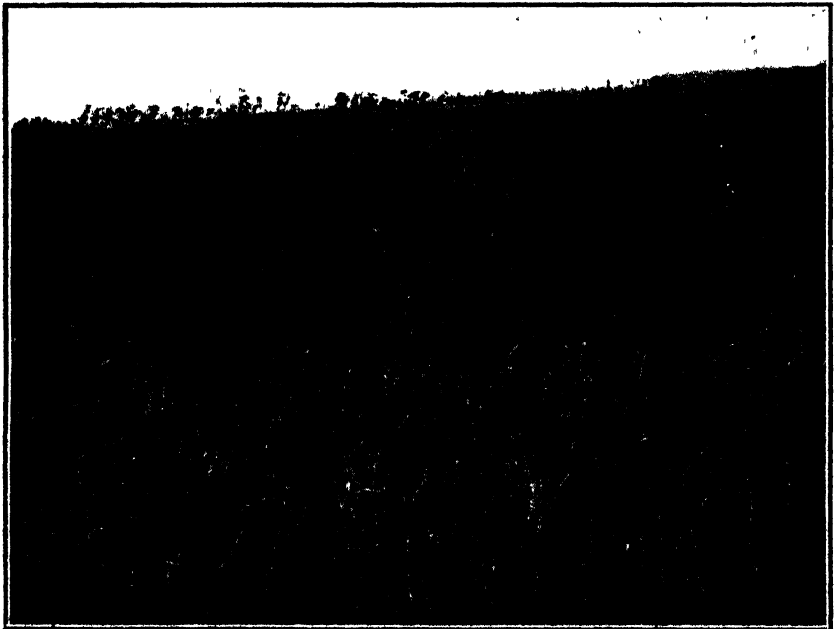


FIG. 4. SUMMER GROWTH OF PASPALUM, SHOWING SHELTER FOR UNFED TICKS WAITING FOR HOSTS.

[Photo by E. Bruce Levy.]

Auckland botanical district, and enjoys an equable and warm climate more suitable than any other in New Zealand for a tropical tick.

This tick is apparently more subject to the influence of climatic conditions when off the host than when attached. The uniformity of climate over the area in New Zealand most heavily infested by the tick, together with the close correspondence between the greatest distance of its range north of the Equator (in Japan) and south (in New Zealand), appears to suggest that the climatic factor has been a marked feature in keeping it so far from spreading farther south in this country.

Topography affects tick-distribution only secondarily by its effect on the vegetation. For this reason, for instance, the tick population of hilly country tends to be concentrated on the valley-flats.

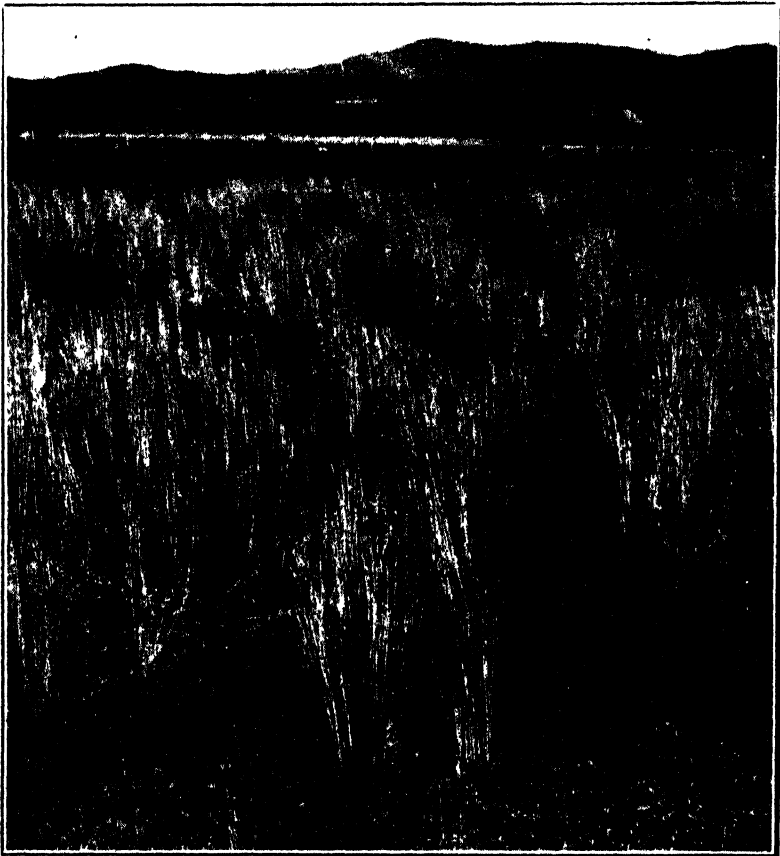


FIG. 5. PASPALUM AND RUSHES IN EARLY SPRING.

The grass has been eaten short, but the rushes sheltered a very heavy population of nymph ticks throughout the winter, and afforded a vantage-point from which they could climb on to cattle in spring. Had the rushes been destroyed practically no ticks could have survived the winter in this paddock.

[Photo by the writer.

Soil factors influence tick-distribution through their effect on the nature of the vegetation. Thus the density of the tick population on the various soil-formations of North Auckland appears to correspond very closely with the prevalence of the grass *Paspalum dilitatum* and the rush or wiwi *Juncus effusus* on these formations.

Botanical factors are shown to be very important for the life of the tick. It is perhaps no exaggeration to state that paspalum and the rush are more important in this regard than all the rest of the vegetation combined. The former supplies most of the summer shelter and vantage-ground for the unfed larvæ and adults, while the latter affords winter quarters to the nymphs, and points from which they may climb on to cattle in the spring. It is safe to say that if paspalum were kept closely grazed and rush clumps destroyed, either by drainage or direct destruction, the decrease in ticks would be enormous.

The presence of suitable hosts is, of course, necessary, although the abundance of ticks is shown to be not directly dependent on the number of the hosts. Thus there are extensive areas in North Auckland surrounded by ticky districts, receiving before the gazettement of regulations numbers of infested cattle, and supporting a heavy population of dairy cattle, and yet they are free from ticks.

HISTORY OF THE CATTLE-TICK IN NEW ZEALAND.

Of the five theories (see also *Journal*, August, 1923, p. 68) advanced to explain the introduction of the tick into New Zealand not one is based on observed fact. Perhaps the most plausible explanations are those which ascribe it to the agency of migratory birds and to imported Indian sacks and bagging-material respectively. The only scientific view must be strongly non-committal.

The first tick of which definite record is available was caught in December, 1910. There is positively no reliable evidence that the tick was in New Zealand more than three or four years previous to this date. The Whangarei (Parua Bay) and Kaitia districts seem to have been the first centres of infestation. In 1917 the increase of the tick had become very marked. In 1919, after cattle-dips had been erected in various parts of the infested area, regulations under the Stock Act were gazetted by which three-weekly dipping of horses, cattle, and dogs throughout the season was made compulsory, and restrictions were imposed on the movement of these three classes of stock. It was found impossible to enforce three-weekly dipping, and so in 1923 this clause was revoked. At the same time sheep were added to the list of stock which must be treated for tick before leaving the area.

ACKNOWLEDGMENTS.

It would be impossible to mention personally all who gave assistance to the writer in the course of the investigation. In the field Messrs. L. Keen, D. Lewis, W. H. Maria, and B. Welsh, and the local Stock Inspectors, notably Mr. J. D. Anderson, of Kaitia, were of special assistance. At headquarters the Director of the Fields Division (Mr. A. H. Cockayne), the Officer in Charge of the Biological Laboratory (Mr. R. Waters), and the Entomologist (Mr. D. Miller) granted every possible facility for carrying out the investigation.

Detailed studies, acknowledgments, and references will be found in the full report.

BRAN AND POLLARD.

THEIR RELATIVE COMPOSITION AND QUALITIES.

L. D. FOSTER, Analyst, Chemistry Section.

WHEN, in the process of flour-milling, the kernels of wheat are broken and gradually reduced, and flour as we know it ultimately obtained, bran and pollard are essential by-products of the many operations to which the wheat has been subjected. Because of their value and extensive uses these two feeding-stuffs are of importance not only in the economy of the farm, but also in that of the mill. There being a considerable difference in their price, it becomes a matter of interest to know what is bran and what pollard.

Every one knows the obvious differences in appearance of bran and pollard. At the same time, to say where bran ends and pollard begins may in certain cases be difficult. The exact point of separation is at present a rather arbitrary one, and one genuine pollard, owing perhaps to a rather "branny" appearance, may look somewhat different from another which is mealy, lighter in colour, and different in feel. The reasons for these differences may become clearer if a few facts concerned with milling are briefly considered.

PROCESSES OF MILLING.

The aim of the miller is to obtain a good quality of flour from the wheat which he mills. Briefly, he does this by removing as completely as possible, with due regard to the quality of product he will obtain, the inner floury portion of the grain from its outer husky covering. The miller subjects the wheat-grain to a whole series of processes by which it is broken or torn and the inner floury part gradually reduced between pairs of smooth rollers. While reducing the flour his object is to keep the branny coating of the grain as whole as possible; this is to prevent it from breaking into smaller and still smaller particles, which might become fine enough to find their way into the flour-stream and so contaminate it. The large flaky appearance of bran shows that to some extent this aim is achieved. A certain amount of disintegration is, however, unavoidable, and pollard consists of these smaller branny particles together with a varying amount of flour which is of low grade, or difficult to remove from the fine branny material to which it adheres.

Separation of these particles of all sizes is brought about by the use of many sieves of varying meshes, until finally the resulting flour is sifted through a sieve of fine silk. Those portions of the wheat-grain which do not pass through the silk form the "offals." Thus, in the first case, are produced flour and offals. There is, however, a further separation of offals into bran and pollard; and though in New Zealand we are familiar mostly with bran and pollard, pollard is occasionally separated into further subdivisions called variously shorts, sharps, coarse and fine middlings, and pollards. As a result of the foregoing processes some wheats produce a larger amount than others of low-grade flour which cannot be sold to the baker; this is then

included with the pollard. Again, some millers will not attempt to remove as much flour from the grain as others. In both cases the pollard will be more floury than otherwise, and so variations in appearance and composition are always likely to occur.

SEPARATION.

The actual point of separation of bran from pollard depends largely upon the milling practice of the individual miller. He uses a sieve of a certain mesh to separate these two products, and the size depends upon what he finds most suitable for the conditions under which he has to work. The sieve may therefore differ in different mills. It is fairly conventional milling-practice, however, to separate bran on a wire sieve (No. 16) with about sixteen meshes to the linear inch. All that material which passes through sieve No. 16 but which does not go into the flour may be called pollard (sometimes also called "offals").

NUTRIENTS IN BRAN AND POLLARD.

Bran and pollard contain valuable amounts of those substances essential to the growth and maintenance of the body and which are called nutrients. These are:—

(1.) Protein: This is a portion of the food containing nitrogen in definite amounts. It is the essential factor in the formation of flesh, muscle, bone, blood, and all those parts of the body which have strength. It is the most valuable of the nutrients, and no other is able to replace it in its work of flesh-forming and body-building. Common examples of protein are white of egg, milk casein, and wheat gluten.

(2.) Ash or mineral matter: This furnishes the mineral matter necessary for the building of bone, and consists chiefly of lime, potash, soda, and phosphorus compounds.

(3.) Fat or oil: Next to protein, fat has the highest nutritive value. It is consumed by the body, and gives out heat and energy, or the capacity to do work.

(4.) Carbohydrates: Under this heading are included starch, sugar, and similar substances. Their functions are similar to fat, but fat is considered to be, weight for weight, more than twice as valuable as carbohydrates.

(5.) Fibre: This constituent has the least value of the six, but a certain amount is necessary to furnish bulk to a feed. Its function otherwise is somewhat similar to that of the carbohydrates, but being less digestible is for that reason not so valuable. The presence in excess of fibre, owing to its lesser digestibility, may reduce the food-value of a feeding-stuff. Bran, containing more fibre than pollard, is the less digestible of the two.

(6.) Accessory food-factors, or vitamins: Finally, there are the vitamins, otherwise known as "accessory food-factors" or "growth-promoting substances." The vitamins bear a very important role in the science of nutrition, but at present little is definitely known about them except that they are essential to growth and the maintenance of life. They are usually present in sufficient quantity in most diets if a certain variety is provided. Bran and pollard contain valuable amounts of the different vitamins.

Bran contains a fairly large amount of protein, appreciable amounts of carbohydrates and fat, and a valuable amount of ash or mineral matter which is rich in phosphorus and potash.

Pollard possesses larger amounts of protein, fat, and carbohydrates, and smaller amounts of fibre and ash, than bran. Being also more digestible, it is more valuable as a feeding-stuff, and commands a higher price.

Samples of pollard vary considerably in appearance. Some have a floury appearance, due to the inclusion of a certain amount of low-grade flour; others are more like fine bran, and do not appear to have any very fine particles included with them. These latter samples are generally lower in protein and higher in fat than the floury samples, and are not quite so digestible.

AVERAGE COMPOSITION.

In 1917 T. B. Wood (*Journal of the Board of Agriculture* (England), 1917, p. 1183) gave the following average analyses of some representative English samples:—

Table 1.—Average Composition of Bran and Pollard.

—			Moisture.	Protein	Fat.	Carbo- hydrates.	Fibre.	Ash.
			Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Bran	..	..	13·6	13·4	3·9	53·0	10·6	5·5
Pollard	..	..	13·7	15·5	4·4	58·5	4·9	3·4

The samples analysed were normal offals. The results obtained possess a definite value, since it was found that there was practically no overlapping in the composition of the pure grades investigated. These figures apply, of course, to English samples. Commercial brans and pollards will be found to vary considerably from these averages, owing chiefly to lack of uniformity in the methods of separation. Figures obtained in other countries differ from those quoted in certain respects, Canadian figures, for instance, being for the most part higher in all constituents except carbohydrates. This result is probably due to the excellent quality of the wheats which are milled in that Dominion.

DIGESTIBILITY.

Recent research by H. E. Woodman (*Journal of Agricultural Science*, Cambridge, 1923, p. 483) emphasizes the fact that if bran and pollard are separated always according to a uniform method they yield grades which are characterized by distinctive chemical composition, both in regard to crude and to digestible constituents, and, it follows, by the possession of well-defined feeding-values. If pollard be separated, as is sometimes done, into further grades, the finer the particles of each particular grade the higher the amount of digestible constituents and the higher the feeding-value. There is, however, a corresponding marked decrease in the amount of mineral matter present. Because of this, though bran and pollard have their different uses, pollard fetches a higher price as a feeding-stuff. To ascertain if this higher-priced pollard, as sold in New Zealand, contained any appreciable amount of

bran the Board of Trade arranged recently to collect representative samples. These were submitted to the Chemistry Section of the Department of Agriculture for analysis and report.

SAMPLES TESTED BY THE CHEMISTRY SECTION.

Fourteen samples were received. One of these was a bran; the others were reputed to be genuine pollards. They were analysed for protein, fibre, and ash, as it was considered that the figures obtained for these constituents would be fair indications of any departure from the average in the samples received. The following table gives the results of the analyses:—

Table 2.—Analyses of New Zealand Samples (1923).

Laboratory No.	Sample.	Moisture.	Nitrogen.	(N. x 6.25) Protein.	Fibre.	Ash.
R 1043	.. Bran	11.04	2.14	13.39	11.41	5.48
R 1032	.. Pollard	11.03	2.42	15.24	3.59	3.28
R 1033	.. "	10.52	2.45	15.31	4.83	3.25
R 1035	.. "	10.67	2.46	15.40	3.57	2.97
R 1036	.. "	10.53	2.45	15.31	3.68	2.90
R 1040	.. "	10.52	2.46	15.40	5.01	3.27
R 1041	.. "	10.85	2.46	15.40	5.51	3.39
R 1042	.. "	10.60	2.48	15.49	5.82	3.49
R 1072	.. "	11.54	2.53	15.81	5.00	3.31
R 1039	.. "	10.59	2.48	15.49	5.78	3.91
R 1034	.. "	10.77	2.31	14.44	6.22	3.99
R 1037	.. "	10.50	2.35	14.70	7.55	3.97
R 1038	.. "	10.63	2.32	14.53	7.34	3.94
R 1071	.. "	11.59	2.24	14.00	5.08	3.29

It will be seen that these figures agree fairly closely with the averages obtained by Wood (Table 1). Since New Zealand wheats resemble to a certain extent those grown in England, this is to be expected.

Sample R 1043 is a genuine sample of bran. This sample is decidedly lower in protein content than pollards usually are, and much higher in fibre and ash content. This analysis is remarkably close to the average figures given by Wood.

The following samples are genuine pollards: R 1032, 1033, 1035, 1036, 1040, 1041, 1042, and 1072. They are all very alike in protein content; and though there is a fairly large difference in the fibre content, the highest amount, 5.5 per cent., is not excessive. The amount of ash is much more constant, never varying much from 3.3 per cent. It is possible that this offers a good means of judging the value of a sample.

About one sample, R 1039, it is difficult to be very definite. It contained a very good amount of protein but for an average pollard the fibre content was rather high, and the ash content decidedly high. Though not possessing an average composition, this may be a genuine pollard.

R 1034, 1037, 1038, and 1071 all contain under 15 per cent. of protein. The first three are higher than average pollards in fibre content. This may be due either to separating the bran on a coarse

sieve or to adulteration. They contain just on 4 per cent. of ash. There is no doubt that these three samples contain more of the outer branny coating of the grain than is usually the case with genuine pollards.

Among the samples, R 1071 occupies an anomalous position. It is low in protein content, but possesses for a pollard an average amount of fibre and ash. These facts are consistent with a pollard containing a certain proportion of both bran and low-grade flour. A physical examination of the sample confirmed the belief that it contained approximately 10 per cent. of fairly large bran particles, together with a certain amount of flour. The protein content of this sample is low, but its digestibility probably greater than an average pollard, and the purchaser in this case would not be prejudiced to any extent because of its branny content. However, since bran and pollard have their distinctive uses, it is desirable that the grades should be kept as pure as possible.

SUMMARY.

Bran and pollard have their separate uses, but pollard is a more valuable feeding-stuff and is more expensive.

A sample of pollard produced in one mill may differ considerably from a sample obtained in another. This is due to differences in milling-practice.

When separated by uniform methods the composition or feeding-value of bran and pollard is well defined within certain limits. Adulteration of pollard with bran, which latter is cheaper, can in these circumstances be detected by chemical analysis.

At present, where there is lack of uniformity in milling, it is difficult to say whether a pollard contaminated with what is really bran has had the latter^a deliberately added to it, or whether the bran has found its way into the pollard owing to the method of separation adopted by the miller.

For the protection of the farmer and the miller, and to make possible the detection of adulteration, it is desirable that methods of separation of bran from pollard in the mill should as far as possible be uniform.

Rabbit Control and Trapping.—Regulations under the Rabbit Nuisance Amendment Act, 1920, relating to the destruction of rabbits in the Moawhango Rabbit District (Wellington), have been gazetted. These provide that every owner of land who is served with a notice to destroy rabbits in terms of the Rabbit Nuisance Act, 1908, must do so either by laying poison or by the fumigation or filling-in of burrows. Where it is desired to substitute other means of destroying the pest, application for permission to do so must first be made to the Rabbit Board, whose decision is final. Further, within seven days of service of the notice, all trapping on the land must cease for a period of not less than three months. The penalty for a breach of the regulations is a fine not exceeding £10.

Autumn-sown oats, in addition to providing considerable green feeding in the early spring, when it is very valuable, generally ripen about the New Year, and may be harvested before there is any chance of Californian-thistle seed maturing.

THE RELATION OF BIRDS TO AGRICULTURE IN NEW ZEALAND.

IX. THE SEA-BIRDS.

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THE title of this, the last general article of the present series to deal with the indigenous birds, may seem at first sight devoid of agricultural interest; but two considerations will serve to justify it. Firstly, the elastic category of "sea-birds" includes many species which, though they may frequent the sea or its vicinity for some portion of their time, yet seek a large part of their food inland, even on cultivated country, thus entering into the most intimate relations with agriculture in the narrowest sense. Secondly, the writers have here, more than in any other article of the series, interpreted the term "agriculture" in the very widest sense, to include the whole of man's direct dealings with the soil on which he lives.

Because the last of the indigenous birds which we shall consider are lumped together as "sea-birds" it must not therefore be assumed that any degree of true relationship exists between the four orders into which they are divided. Even their ecological relationships—that is, those deduced from a study of habits and habitat—are only very general. Their chief common feature is a certain degree of dependence on the sea, but one or two species share scarcely even this characteristic.

THE GULLS AND TERNS.

Owing largely to the long coast-line and to the accessibility of most portions of New Zealand to the sea few birds are more familiar than the "seagulls." Two species in New Zealand are among the commonest of birds. A third, the black-billed gull (*Bruchigavia melanorhyncha* Buller), is almost solely an inland species, but is now very rare. As it has been observed feeding on moths among the tussocks it must be considered a beneficial species. The useful activities of the common gulls find outlet in two directions—firstly, the scavenging of the shore-line, and, secondly, the destruction of insect pests of the farm. The casual observer idly watching the gulls on the beach appreciates nothing of that almost ceaseless food-hunt which disposes of a whole host of otherwise offensive material, all of which finds a welcome in the omnivorous stomachs of the gulls. The concourse of these beautiful birds at the refuse-outlet of the abattoirs at Ngahauranga, where they feed possibly both on the waste and on the smaller of the fish attracted to it, is one of the sights near Wellington.

The terns, less well-known but nevertheless easily recognized by their long pointed wings and even longer forked tail, are more exclusively fish-eating than their cousins the gulls, but at least one of them, as described later, feeds to some extent on worms and grubs.

The Black-backed Gull (Larus dominicanus (Licht.)).

Every one knows the large gull, with its handsome yellow bill, black back and wings, and pure-white head, neck, and underparts; but not

all are aware that the common mottled brown and grey gull of the same size is an immature bird of the same species not yet come into possession of the adult livery of black and white. The black-backed gull nests almost all round our coasts, "on tidal drift, on edges of cliffs and promontories, on bare rock" (Guthrie Smith).

Owing to its bad reputation on the sheep run this gull is not protected by law. It is extremely doubtful, however, whether the damage to occasional lambs and sick sheep, and the theft of toheroas and other molluscs ("shell-fish," so-called), which it breaks in a characteristic way by flying with them to a height, from which they are dropped on to either rocks or hard sand, outweigh the good services rendered by this bird in season and out of season as a peripatetic scavenger on our beaches and a destroyer of noxious insects in our fields. The writers have no definite proof that the large gull ever attacks live healthy lambs, but there can be no doubt that dead lambs and sheep, and possibly sick or isolated lambs, may have their eyes picked out by this bird. The eyes seem the first point of attack in the method of the gulls, cast-up fish on the beach being treated in a similar fashion. Doubtless much confusion, which we are not yet able to clear up, exists between the work of harrier-hawk and of black-backed gull in sheep districts. We regret to find so little definite information. Mr. E. B. Ford, however, has written from Canterbury to state his opinion that the harrier often is blamed for damage committed by the gull. He writes. "The gull is very destructive to lambs. I have seen them following a ewe and a new-born lamb round the paddock, and the ewe trying to drive them away." Buller remarks on the same subject: "It is said that on the sheep-farms they are destructive to the young lambs. This is quite possible, although I think it more likely that they confine their attention to the dead and dying; and the latter would undoubtedly be attacked by having their eyes torn out, because that is the habit of this bird."

The same authority (Buller), writing at a time when the black-backed gull was protected, draws attention in the following words to the good work which it performs: "The protection of the seagull is undoubtedly having a very good effect, and a wise protection it is, for there is not a more useful bird as a scavenger of our harbours. They have recognized this fact in San Francisco, where, I understand, the penalty by law for killing a seagull is three months' imprisonment without the option of a fine."

In an earlier work Buller mentioned the good services of this bird to agriculture: "It also frequents the pastures at a distance from the coast in quest of food, doing good service to the farmer by its large consumption of caterpillars and other insect pests . . . To the agriculturist these birds, coming in such numbers and preying upon insect life, must prove of incalculable service . . . In Napier, where the cultivated grounds were at one time infested with the introduced snail (*Helix hortensis*) this gull was found to be quite invaluable."

The black-backed gull's activities, then, may be summed up in the following terms: It is highly beneficial on two counts—firstly, as a general scavenger, especially on the coasts, and, secondly, as a destroyer of noxious insects and their grubs; while it is said to be injurious on



FIG. 1. NEST AND EGGS OF BLACK-BACKED GULL.

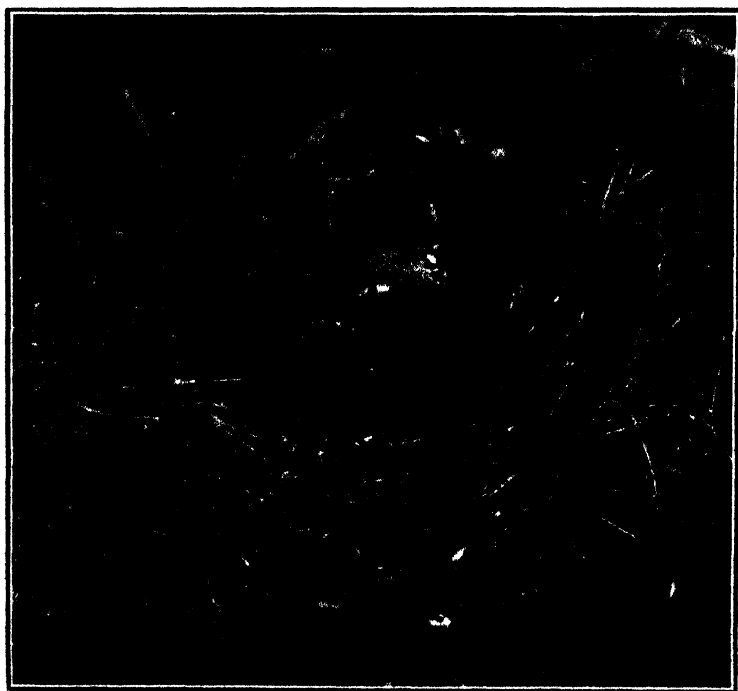


FIG. 2. YOUNG OF BLACK-BACKED GULL, AND EGG JUST HATCHING.

[Photos by T. Cockcroft]

sheep-stations, although no definite proof is forthcoming that it ever kills healthy sheep or lambs. In districts where sheep-farming is not the leading industry there can be no doubt that this bird should again be placed on the protected list.

The Red-billed or Mackerel Gull (Bruchigavia novaehollandiae (Stephens)).

This beautiful bird is easily distinguished from the larger species not only by its diminutive size but also by its grey mantle, the only black on its plumage being confined to the markings of the primary wing-feathers. The immature bird resembles the parent save that the wings are marked with brown, while the plumage generally is dingy, and the legs, feet, and bill blackish, the clear red of these organs being an adult feature.

In its nesting-habits this gull is more prone to assemble in colonies than is its larger congener, while the site of the nest itself is usually in a more precipitous location.

Economically the mackerel-gull, although it feeds to a considerable extent on fish, yet strongly deserves the protection which is accorded to it by law. While perhaps less active as a scavenger than the black-backed gull it is considerably more assiduous in the pursuit of insects on cultivated and pastoral ground. Especially in the north of the North Island it frequents inland fields and pastures in flocks of almost incredible size. These are particularly noteworthy during the winter months.

Buller mentions whole acres in the Thames district covered with these small gulls, devouring crickets as fast as they could pick them up. In the opening article of this series one of the present writers described a similar occurrence on a much larger scale, when in 1848 the crops of the Mormon settlers in Utah were saved from wholesale devastation by flocks of gulls which destroyed the threatening swarms of grasshoppers.

Flocks of mackerel-gulls feeding on pastures in North Auckland in February were observed to be chasing, with neck outstretched, flying insects which they disturbed from the grass. In another locality in North Auckland, a month later, one mackerel-gull, after feeding on pasture, was found to have devoured fourteen earthworms averaging $2\frac{1}{2}$ in. in length, one pupa or chrysalis (resting-stage) of *Agrotis ypsilon* Rott. (the injurious black cutworm), and one adult moth of the same species. There is thus a possibility that the insects pursued by the gulls on the previous occasion were also moths, this species being particularly abundant in grass-paddocks.

Leach, writing of the same gull in Australia, states: "Though a dainty-looking bird, it has a bad character. It is worse than any bird of prey for stealing eggs and young birds, for let a gannet or other nesting bird but leave the nest for a moment, and gulls quickly rob it of its contents. They are scavengers, and eagerly follow a ship at lunch-time to gather the scraps." There are indications that in New Zealand also it is probably as great a pest to its fellow sea-birds, but such a habit, involving as it does no disturbance of the balance of nature, obviously influences in no degree our estimate of its economic worth. The economic value and the aesthetic charm of the mackerel-gull are alike extreme.

Before leaving the gulls we should perhaps mention the fact that these birds have been accused of spreading the cattle-tick in North Auckland. It has been elsewhere pointed out, however (this *Journal*, August, 1923), that such a belief is founded almost certainly on a confusion between the cattle-tick, which has not yet been recorded from gulls, and one of the sea-bird ticks which are well known to attack these birds.

The Terns.

The black-fronted tern (*Chlidonias albigularis* (Gray)), which is one of New Zealand's own peculiar possessions, subsists less on fish than either of the two common species—the white-fronted and the Caspian. In the South Island particularly it used to be a common sight to see large flocks of these beautiful birds following the plough, ever and anon descending to seize a worm or grub from the fresh-turned soil. Such a spectacle may even yet be seen in parts of Canterbury and Otago, but, unfortunately, the bird is far less abundant than it was in the early days of settlement. Buller writes of this species: "It also frequents the cornfields and pastures, and, by devouring caterpillars and other insect pests, proves itself a valuable friend to the agriculturist."

The Caspian tern (*Hydroprogne caspia* (Pallas)) and the white-fronted tern (*Sterna striata* (Gm.)) prey very largely on small fish, which they capture by means of a characteristic dive. We are not aware that these birds have in any part of the world been accused of any great damage to fishing interests. Their economic relationships cannot be considered very striking, but the beauty of the terns is such that the absolute protection extended to them all by law is a matter for congratulation.

THE GANNET AND THE SHAGS.

We shall dismiss the New Zealand gannet (*Sulita serrator* (Gray)) in a few words, on the same terms as the fish-eating terns. It is, of course, entirely marine, so that only sea-fish form its prey. The gannet is far more exclusively fish-eating than the shags, yet the former is protected while the latter are almost universally condemned. The reason for this anomaly is not far to seek; it is as enemies of trout that shags are persecuted. The marine fish killed by gannet, shags, and terns combined are evidently negligible in quantity. There are still "more fish in the sea than ever came out of it," and so in any consideration of the economic relations of shags we can neglect their marine fishing entirely. Moreover, any species of shag which can be proved to confine its activities entirely to salt water should therefore be added to the list of protected birds.

New Zealand possesses not only a much larger number of different species of shags than any other country in the world, but also a remarkable abundance of individuals, occurring from the waters of the ocean itself to the reaches of the smaller rivers and lagoons. There are altogether at least nine distinct species of New Zealand shags or cormorants, of which eight occur on the mainland and concern us here. Not a single one of these eight is protected. Faced with this multiplicity of totally distinct kinds, every one of which has its special haunts and its own peculiar feeding-habits and food, we plead above all for

a recognition of these differences and for an impartial examination of the various species, in order that discrimination may be exercised between those which are injurious to the trout and those which certainly are not. By such a simple scientific procedure, firstly, the sums paid annually for shags' heads may be considerably reduced; secondly, a reproach to our protection laws may be removed; and, thirdly, a number of entirely harmless and interesting species may be preserved for posterity.

Of the eight mainland shags, one, the little black shag (*Mesocarbo ater* (Lesson)) has been but infrequently recorded, and that only from North Auckland, and on that account need not concern us here. The rough-faced shag (*Hypoleucus carunculatus* (Gm.)) occurs in its typical form only in the northern portions of the South Island. It is a beautiful species by no means abundant, and it confines its activities to the sea itself. Fish form but a small proportion of its food. Steps should certainly be taken to protect this economically harmless bird.

We are left with six kinds of shags on whose head is visited most of the ill feeling with which shags as a group are regarded. Before dealing with their specific characteristics it will be advantageous to make a few general observations. Writing of shags in general, Guthrie-Smith states:—

Except on my own lake at Tutira, I believe there is no part of New Zealand where the destruction of shags is not thought to be a righteous action. Everywhere the unfortunate birds are persecuted as the destroyers of fish, and fish they do undoubtedly take. On our rivers and fresh-water lakes they are believed to harm the imported trout, and on our seas to be a menace to the fisherman's interests, and it may indeed happen that in some districts, under certain conditions, and for a time, shags are harmful. Those, however, who have most closely observed the conduct of feeding shags believe that the captures made in waters where both trout and eels abound are generally of the latter.

On the salmon-rivers of Scotland, the Dipper used to be shot down until he was proved to be not an enemy but a guardian of the salmon-ova. In Victoria, too, the destruction of shags has resulted, not in an increase, but very great decrease of fish in the Murray River, its billabongs and lakes.

Anglers and fishermen, like the rest of mankind, are but too prone to rush to conclusions based on insufficient evidence, and both in Scotland and Victoria, persistent observations and experiments have shown that the birds fed chiefly on the enemies of the fishes' eggs.

My local experience, too, goes to prove that the presence of shags in considerable numbers is no bar to stocking suitable water. On Tutira the trout are increasing fast, although on the lake and on the run I have allowed no shags to be molested in any way whatsoever; and it may yet prove in New Zealand that the indiscriminate slaughter of shags will turn out to be inimical to the very interests sought to be preserved.

In Stewart Island saleable fish is mostly obtained in the open sea, yet the shags of every species draw their main supply of food from the inlets. At any rate, it is quite unlikely that every species of shag does equal harm, and it may well happen that some of these persecuted breeds destroy crustacea that take the eggs and fry of the blue cod and other marketable fish.

Leach, in summing up the position in Australia, states: "One thing is certain—fish were formerly much more abundant, so were cormorants." Mattingley, giving his testimony in Australia, writes: "To destroy those creatures that prey upon the enemies of the fish ova and fry is tantamount to destroying the fish themselves, and in the destruction of the cormorants this procedure is exemplified."

Coming back now to those six species of mainland shags which are sufficiently abundant to need economic investigation, we find that

the following kinds are too exclusively marine to be accused of attacking trout: The Stewart Island shag (*Hypoleucus campbelli stewarti* (Grant)), the bronze or pink-footed shag (*H. chalconotus* (Gray)), and the spotted shag (*Stictecarbo punctatus* (Spar.)). Concerning the last one Mr. R. A. Falla, on whose wide knowledge of sea-birds we are again drawing, writes: "This beautiful endemic species differs in several respects from the other New Zealand shags. Particularly noticeable is its weak flight, accompanied by short rapid wing-beats. As a matter of fact these birds spend the greater part of their lives on or near the rock ledge on which they were born." Speaking of their nesting-sites he states: "The headlands and cliffs occupied are situated (in two cases) in the open sea, with 16 to 20 fathoms of water at the base. This enables the shag to obtain his chief food—minute free-swimming crustaceans—within a few yards of the nest. These are easily obtained and quickly digested, and are supplied to the young by regurgitation. Pasty masses of semi-digested food can often be seen beside the nests, varying in colour from red to brown and grey, evidently different species of crustacea. A young spotted shag from the West Coast was found to contain large masses of the small red shrimp-like creature known as "whale-feed" (*Munida gregaria*)." Mr. Falla further points out that "available evidence seems to show that our oceanic shags, while structurally adapted for capturing any free-swimming creature, prefer those most easily obtained and digested."

The pied shag (*Hypoleucus varius* (Gm.)) must also be regarded almost solely as a marine species. Mr. Falla informs us that although it is found in tidal streams occasionally he has never seen it on inland waterways. Probably any report of this species inland is based on confusion with the similarly coloured though smaller white-throated shag.

We arrive then at this conclusion: that the only two shags which can possibly be enemies of the slightest importance to trout are the white-throated shag (*Microcarbo brevirostris* (Gould)) and the black shag (*Phalacrocorax carbo* (Linn.)), both of which seek a considerable portion of their food in fresh water. We cannot too strongly emphasize the fact that if any shags at all are to be outlawed it should be these two only. Having arrived at this conclusion, we must now examine the evidence for and against shags as enemies of trout. Although both the last-mentioned species are implicated, the black shag, by reason of its superior size and greater abundance, is probably the one most frequently concerned. With regard to the white-throated species Mr. Falla writes: "I have examined the stomach-contents of only one of these birds . . . It contained three eels about 6 in. long and a small fresh-water crayfish." Buller found the "stomach filled with fresh-water shrimps." The white-throated shag is particularly plentiful in the streams of the North Auckland district, where trout are in most cases not present. There eels and crayfish must certainly form the major part of its food.

The black shag, since on it is concentrated most of the warfare against shags, needs special consideration from an economic viewpoint. In this connection the evidence of Mr. Edgar Stead, as that of an angler of lifelong experience, must be especially emphasized. Speaking solely of the black shag, he states:—

And while I would be the last person to deny that the shag does take trout, I am thoroughly convinced that he deserves much more consideration from anglers than he usually receives. The chief point to which I would call attention is the indiscriminate slaughter of the shags caused by the price that is put on their heads. On this account birds are killed which have been bred on the sea-coast, have lived in salt waters or estuaries, and have probably never even seen a small trout in all their lives.

In many waters where there are both eels and trout the shags do a great deal of good by their attacks upon the former. Some years ago I shot nineteen shags on the Lower Selwyn, and cut them open to see what each of them had in its stomach. Seventeen had eels, one had some small fresh-water crayfish, and one had a small trout about 7 in. long. Therefore, regarding even the bird that was eating crayfish as doing damage by taking trout-food, the amount of good done by the seventeen is out of all proportion to the damage done by the two. I do not think that the harm an eel does to trout is generally recognized. Being largely a bottom-feeding fish, it is an especial menace during the spawning season. A 2 lb. eel could easily eat all the spawn of a 5 lb. trout, and is just the right fish to find it But the damage done by eels in trout-streams is not confined to their depredations among the trout themselves. Owing to their large appetites they eat enormous numbers of small fish that would otherwise serve as food for the trout. This effect of the presence of eels may be likened to that of rabbits in sheep-country.

The reasons for a shag's preference for eels are many. Weight for weight, an eel is more nourishing than a trout. But a shag can with ease swallow a 1½ lb. eel, while it can only manage a 1 lb. trout with difficulty. The bird's method with an eel is to swallow it head first, getting about 4 in. of the fish into its stomach, the remainder being in its neck, fly to some convenient perch, and there sit throughout the process of digesting, letting the eel slide down gradually as it is digested. . . .

The young do not, unless disturbed, leave the nest until they are well able to fly, which is about six weeks after they are hatched. During this period they are fed by regurgitation by both parents. At first this requires no especial effort, the old birds delivering a small quantity of wholly digested food to the young. Gradually, however, as the offspring grow and their appetites increase, the old birds present their food in a less and less digested condition, at the last giving it up quite whole. Here is where the eel is most appreciated over the trout as a form of diet, the greater quantity which can be carried at a time and the marvellous ease with which it can be disgorged making it practically the staple nourishment of the young shags in districts where it can be easily obtained. . . .

The old birds always swallow their prey head first. Thus a fish which is too long to be turned inside the bird has to be taken by the young bird tail first and swallowed that way. In the case of an eel this would make little or no difference, but with a trout it would, more especially if the parent, as it naturally desires to do, brings large fish to the nest. The result is that the fish, jamming in the young bird's throat, is rejected.

I may be wrong, but it seems to me there are many more eels at the mouth of the Selwyn now than there were ten years ago, when I first fished there. At the same time there are unquestionably fewer shags. In the shallows at the north-east corner of the lake, where I was shooting for some seasons, there were noticeably fewer eels than round the mouth of the Selwyn, and this I attribute largely to the presence of a flock of about fifty shags which fished there. . . .

And now I come to the actual taking of trout by shags. As I have already said, in districts where there are eels the number of trout taken is smaller than is usually imagined; and there are very few streams in the South Island where eels are not plentiful At the same time there are, I believe, many streams in the North Island which are almost if not entirely devoid of eels. Yet even there I claim that the shag is not an unmitigated evil.

Most persons, will, I think, agree with me that the danger with many of our streams and rivers is not of their depletion of trout but of overstocking. Most of us also are well aware of the degeneration that takes place in any race that has no natural enemies—where, that is to say, there is no agent that will bring about the survival of the fittest. In the case of trout an eel can be of little use as such an agent, since by eating the ova it destroys the trout before the latter has had an opportunity of showing its fitness or otherwise. A shag, on the

other hand, taking trout of anything from 4 in. to 5 in. long, is almost certain to get the weaker members of a shoal of trout first, the stronger escaping by their superior agility and swimming-powers. I suppose that of th. trout in the Avon 10 per cent. are miserable, long, thin kelts, weighing anything up to 1½ lb. I think you would have great difficulty in finding any such percentage in a stream, where there are shags fishing, and it is my opinion that a few shags fishing in the Avon would soon reduce this percentage there.

I have heard [1908] that there is a marked deterioration both in size and condition of the fish in Lake Rotorua, which is generally ascribed to overstocking. The great danger that then exists is that some diseases will break out and entirely deplete our overstocked streams and lakes, but to ensure that none but healthy fish will reach maturity a colony of shags is exactly what is required.

Buller is the only ornithologist we have read who was wholeheartedly against the black shag. He writes: "This is, I think, the only native bird to which protection ought not to be extended."

Mr. J. R. Annabell, a most careful observer, writes: "Most suitable streams are now stocked with trout, and I am of opinion that the shag is of benefit to the trout . . . He certainly helps to keep the eels in control, and one large eel can eat as many young trout as a shag."

To sum up the shag position, of the eight species of shags occurring on the mainland two are too rare to need economic consideration; four are almost exclusively coastal shags, feeding by no means entirely on fish, and even then doing no appreciable damage to fishing-interests; and, finally, only two fish to any extent in fresh water, and of these only one has ever been proved to catch trout. Regarding this last one, the black shag, it is still by no means certain that it is not more of a friend of the angler than a foe. Its persecution should not be subsidized, but whether it should be positively protected, as should be indubitably all the other species, is another matter, to be decided by impartial scientific investigation.

THE PETRELS.

New Zealand possesses no fewer than forty-one species of petrels, ranging in size from the diminutive storm-petrels to the enormous albatross so well known to ocean voyagers.

The most direct claim of the petrels to economic consideration is a gastronomic one—the young birds are still used very extensively as food, particularly by the Maori people. The taste for this food, however, is not peculiar to New Zealand. Thus Leach, writing in Australia, states: "The remarkable colony of people living on Cape Barren Island is entirely dependent on the the annual mutton-bird harvest. They claim to take about a million and a half birds each year. The number is probably much exaggerated, for Littler, in his valuable "Birds of Tasmania," gives the number as 555,000 for 1909, valued at about £4,000 . . . Flinders calculated that one flock of these birds he met in Bass Strait contained 132,000,000 birds."

The writers are deeply indebted to Mr. R. A. Falla, who is recognized as the New Zealand authority on petrels, for the following comprehensive account of the species which are actually taken for food:—

1. *Neonectris griseus* (Gm.) (sooty shearwater): This is the common commercial mutton-bird, and is the one taken in such immense numbers from Stewart Island and islets in Foveaux Strait. The usual practice is to collect

the young birds just before they leave the nest about March of each year. Occasionally a few adult birds are taken and potted in the same way at odd times during the breeding-season (November to March).

2. *Neonectris tenuirostris* (Temm. and Laug.) (short-tailed shearwater): This bird, which is the commercial mutton-bird of Tasmania and Bass Strait, seems to occur only as a straggler in New Zealand waters, and, as far as our information goes at present, does not breed here.

3. *Puffinus assimilis* Gould (allied shearwater): According to Reischek the young of this species were at one time collected by the Maoris on the Chicken Islands in February. These islands are not now visited, and the bird is not found in any numbers elsewhere.

4. *Puffinus gavia* (Forster), *Reinholdia reinholdi* (Mathews), (Forster's shearwater): This species breeds in large crowded colonies on several islands in Hauraki Gulf and off the northern coast. They are still subjected to occasional raids by the natives, March being the favourite month, when the young are just ready to fly.

5. *Hemipuffinus carnespes* (Gould) (fleshy-footed shearwater): This bird is slightly larger than the sooty shearwater, and is probably the commonest mutton-bird of the Northern coast natives. It breeds on most of the islands from the Bay of Plenty northward. A Press notice of 3rd January, 1920, reporting the capture of two thousand mutton-birds on Plate Island, probably referred to this species. These must have been adult birds, as the egg does not usually hatch until the first or second week in January. Although the present-day Maori hunts less frequently he probably does more harm than his ancestors, who observed regular seasons and never wilfully damaged a nesting-burrow.

6. *Procellaria parkinsoni* (Gray) (black petrel): Hauturu, or Little Barrier, was at one time regularly visited by Maoris in search of the young of the black petrel. Probably a few are still taken from breeding-places in the Bay of Plenty. The bird is a late breeder, the full-grown young being found in May.

7. *Pterodroma macroptera* (Smith) (grey-faced petrel): Small colonies of this species occur commonly in the northern part of New Zealand. On both east and west coasts the young bird is still taken by the natives for food.

8. *Pterodroma inexpectata* (Forster) (mottled petrel): With the following species, the adult of this petrel was once taken in large numbers by the natives during its flights to inland breeding-grounds.

9. *Cookiella cookii* (Gray) (Cook petrel): The common practice in capturing this and the last species was to light fires and spread nets on some hilltop directly in the birds' line of flight. Urewera natives inform me that this method is now seldom practised, but that young birds of either Cook's or the mottled petrel are sometimes obtained from burrows in the inland ranges.

10. *Pachyptila vittata* (Gm.) (broad-billed prion): According to Mr. R. S. Sutherland, the young of the broad-billed prion are sometimes taken by the Stewart Island mutton-birders along with those of the sooty shearwater or common mutton-bird.

11. *Thalassarche melanophrys* (Temm. and Laug.) (black-browed mollymawk): Until quite recent years the natives of the Chatham Islands regularly collected the young of this albatross for food, and no doubt they are still taken occasionally.

Several of the species breeding on the outlying islands are used by visiting parties such as sealers, or temporary settlers—e.g., *Pterodroma neglecta* (Schlegel)—on the Kermadec Islands.

Finally, Mr. H. Guthrie-Smith informs the writers that in addition to certain of the above species the diving-petrel or kuaka (*Pelecanoides urinatrix* (Gm.)) is taken by the Stewart Island mutton-birders. He believes also that two other species of uncertain identity are collected in the trade.

It should be emphasized that such indiscriminate collecting is strictly illegal. The only New Zealand petrel which is not specifically protected under the Animals Protection and Game Act, 1921, is the true mutton-bird (*Neonectris griseus*), and it is to this species, therefore, that all legitimate mutton-birding must be restricted.

THE PENGUINS.

Those highly interesting birds the penguins, with their amazing adaptations to an aquatic existence, are particularly well represented in the New Zealand region, from which nine distinct species are recorded. Only one of these, the blue penguin (*Eudyptula minor* (Forster)) is plentiful on the mainland, while none are important economically. The diet consists largely of fish and cuttle-fish.

This concludes our account of the economic relations of New Zealand indigenous birds, with the single exception of the kea. A special article on this interesting bird is in preparation as the next contribution to the series.

REFERENCES.

The usual reference works of Buller, Guthrie-Smith, and Leach have been listed several times in previous articles of this series. Their repetition would serve no useful purpose. Others are as follows:—

MATTINGLEY, A. H. E. (1908): Cormorants in Relation to Fishes. *Emu*, vol. 8, pp. 18-23.

REISCHEK, A. (1886): Observations on *Puffinus assimilis* (Gould). *Trans. N.Z. Inst.*, vol. 18, pp. 95-96.

STEAD, EDGAR F. (1908): The Black Cormorant in New Zealand. *Emu*, vol. 8, pp. 71-76.

NOTE.—Mr. R. H. Stidolph's name was inadvertently omitted as the photographer of Fig. 2 in the last preceding article of this series. The writers are indebted to Mr. Stidolph for his kind permission to use this photograph.

CALCIUM CYANIDE FOR RABBIT-FUMIGATION.

IN the course of the past nine months the Live-stock Division of the Department has carried out a number of trials with calcium cyanide (in the powder form) as a fumigant for rabbit-destruction. The tests so far indicate that this material, while very effective and rapid in its action once the gas given off by it comes into contact with the rabbits, is slower and more laborious to apply than carbon bisulphide. The latter fumigant, which has been in very effective and satisfactory use by New Zealand farmers for a number of years, possesses the advantage that a small quantity can be applied to a rag and left to do its work in a warren, whereas a mechanical blower is required for the use of calcium-cyanide powder. The flake form of calcium cyanide, which is claimed to do its work automatically, has not yet been thoroughly tested by the Department.

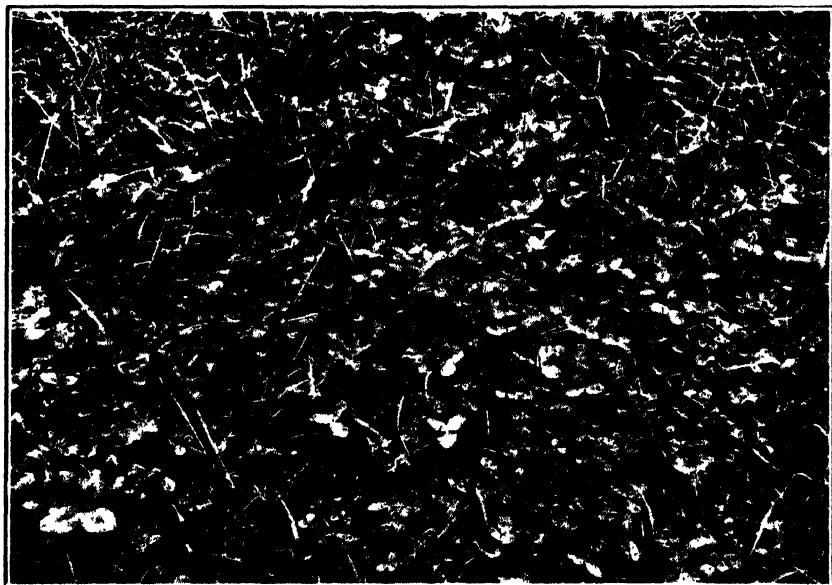
The tests with calcium-cyanide powder were mainly carried out—under both dry and damp conditions of soil—in light country in the Waikato district, where rabbits burrow deep, and thorough work and efficiency of any fumigant is required to reach the lower levels of the warrens.

It may be added that the attitude of the Department towards the use of calcium cyanide is entirely open-minded. It appreciates the use of any effective agent in rabbit-control, and recognizes that different fumigants may all have their own advantages under varying conditions. Successful work with calcium cyanide has been recorded from Australia.

INTRODUCTION OF CLOVER INTO PASTURES BY SURFACE-SOWING.

J. W. DEEM, Supervisor, Moumahaki Experimental Farm.

A PASTURE, to give the best results either for fattening or butterfat-production, must have in addition to suitable grasses a good mixture of clovers. It frequently happens that after a paddock has been down a few years the clovers run out and the amount present is very small, with a consequent reduction in the feeding-value of the pasture. It is also well known that clovers exert a good influence on the grasses, which always do better if there is a fair amount of clover present.



GROWTH OF SURFACE-SOWN CLOVER AT MOUMAHAKI EXPERIMENTAL FARM.

A good demonstration of these facts was recently afforded at Moumahaki, where we had a well-sheltered paddock carrying a good sole of cocksfoot, rye-grass, crested dogstail, and *Poa trivialis*, but very poor in clovers. It was noticed that every time the dairy herd was put in this field the cows did not settle and went down in their milk-yield. It was not convenient nor desirable, for several reasons, to break up the field, and it was decided to try and introduce clover by surface sowing. On 1st September last a mob of three hundred ewes was put in the field, which contained 17 acres. On the 5th 2 lb. each per acre of cow-grass and white clover were broadcast. The sheep were left for another two days, when they were removed. The field

was then rolled and shut up for about three weeks. The clover germinated and grew well, with the result that the pasture is now a splendid mixture and relished by the dairy herd. The accompanying photograph gives a good idea of the growth of clover.

This demonstration is in keeping with other tests in the same district. There is no doubt that where the clover content has become small and the other grasses are still vigorous it will pay to surface-sow a few pounds of clover in the spring.

IMPORTATION OF FERTILIZERS IN 1923-24.

ANNUAL STATISTICS AND NOTES.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

STATISTICS of artificial fertilizers imported into New Zealand during the year ended 31st March, 1924, are now (by courtesy of the Comptroller of Customs) available for study.

The phosphate importations are the principal feature of all fertilizer work in New Zealand. The consumption of phosphates may be considered a rough index of the amount of cropping and other intensive agriculture which is from time to time taking place. Judged from this viewpoint, the figures for phosphates covering the period under notice must be considered extremely satisfactory, as the weight of crude phosphate rock imported to be manufactured into finished fertilizer constitutes a record.

It is to be hoped that all rock phosphate which is not manufactured into superphosphate in the Dominion will be ground to the greatest degree of fineness possible. Finely ground rock phosphate is an excellent fertilizer, but when it is ground coarsely and applied to the soil the coarse particles are not available as plant-food. Further, as phosphates usually become less available in the soil, the distribution of coarsely ground phosphate-rock must lead to an economic loss, which may represent in the aggregate a very large sum. If the proportion of coarse particles is 10 per cent. it is a figure considerable enough, but when it amounts to, say, 30 per cent. a much larger amount of phosphate must be wasted. Ground phosphate rock for application to the soil as such should be ground to the same fineness as basic slag. The Department of Agriculture will test free of charge any phosphate-rock which a farmer thinks is too coarse, and, if evidence is obtained to confirm such suspicions, will have an official sample taken free of charge to the farmer, and will inform him of the result of the test of the official sample.

The importation of basic slag has increased to double that of the previous year, most of the material coming from Belgium. Another favourite fertilizer on the list, which no doubt owes much of its success to its fineness, is Egyptian phosphate (or "Ephos"). This substance appeared on the New Zealand market after a lapse of two years during

which none was imported. The figures for bonedust are double those of the previous year, but the amount imported is comparatively small. A small amount (only 255 tons) of superphosphate was imported, and it does not appear why even this was necessary, seeing that all the requirements of this fertilizer can be readily manufactured in New Zealand.

The other items given in the accompanying tables call for no special comment this year.

SUMMARY OF FERTILIZER IMPORTATIONS, 1923-24 AND 1922-23.

Fertilizer.	Quantity		Declared Value.	
	Year 1923-24.	Year 1922-23.	Year 1923-24	Year 1922-23.
	Tons.	Tons.	£	£
Bonedust	1,158	2,146	39,541	24,205
Bone-char	50	215	447	1,797
Basic slag	39,032	19,641	124,505	82,732
Superphosphate	255	.	985	..
Rock phosphate (raw) and guano	76,517	69,591	108,110	124,672
Egyptian basic phosphate	5,996	.	18,138	..
Kaimit	3,975	3,894	9,557	10,481
Muriate of potash .. .. .	.	60	..	627
Sulphate of potash	863	592	9,241	6,868
Potash, other	200	670	1,314	3,270
Gypsum	1,979	1,493	2,583	2,398
Sulphate of ammonia	842	430	5,439	7,420
Nitrate of soda	748	386	9,646	5,426
Sulphate of iron	63	53	549	606
Fertilizers unspecified	15	6	265	286
Totals	135,383	99,483	330,389	270,788

NOTE—With regard to the "declared values" given above, the Comptroller of Customs supplies the following explanation: "The value for duty is defined as the fair market value in the country whence the goods are imported, plus 10 per cent. As the addition of 10 per cent. does not cover the present freight, insurance, and other charges, the statistical value is less than the actual landed value."

IMPORTS OF THE PRINCIPAL PHOSPHATIC FERTILIZERS FROM 1914 TO 1924.

Year ended 31st March.	Bonedust.	Basic Slag.	Superphosphate.	Raw Rock Phosphate and Guano.	Egyptian Basic Phosphate.
	Tons.	Tons.	Tons.	Tons	Tons.
1914	6,578	30,350	41,582	22,093	Nil
1915	7,966	29,385	54,190	23,983	..
1916	10,059	10,339	58,013	39,366	2,026
1917	10,386	6,660	31,962	24,993	8,614
1918	6,363	10	37,157	37,037	11,225
1919	3,468	Nil	21,400	31,351	Nil.
1920	6,272	2,759	15,842	38,861	15,000
1921	4,440	10,823	40,731	70,208	10,810
1922	4,063	13,488	3,140	45,956	Nil.
1923	2,446	19,641	Nil	69,591	..
1924	4,158	39,632	255	76,517	5,996

IMPORTATION (IN TONS) OF PRINCIPAL ARTIFICIAL FERTILIZERS FOR YEAR ENDED 31ST MARCH, 1924, SHOWING COUNTRIES
OF DEPARTURE AND NEW ZEALAND PORTS OF ENTRY.

New Zealand Port of Entry.	Australia.			Chile, India.		United States of America.	Pacific and Indian Ocean Islands.		United Kingdom.		Belgium.		France.		Germany.	Luxembourg.	Egypt.	Netherlands.
	Nitrogenous Manures.	Bonedust.	Gypsum.	Nitrate of Soda.	Bonedust.		Name of Island.	Rock Phosphate.	Nitrogenous Manures.	Basic Slag.	Potash.	Basic Slag.	Potash.	Basic Slag.				
Auckland	189	2,758	1,965	75	835	500	{ Nauru .. 18,042 Ocean .. 14,000 Makatea .. 17,829 }	155	5,596	265	15,423	..	692	1,673	600	1,000	..	..
Kaipara	..	100	..	..	..	500	..	..	..	7,450	25	..	..	48	495	..	..	..
New Plymouth	..	355	..	..	..	..	..	..	..	30	..	..	..	..	..	..	..	..
Patea..	..	..	..	..	..	..	..	..	..	50	..	..	..	..	..	..	..	..
Wanganui	..	..	..	..	..	..	New Caledonia	808	..	..	..	..	..	..	..	..	..	..
Napier	..	..	..	..	..	..	..	..	..	750	30	..	..	25	..	5	..	..
Wellington	90	..	..	490	..	..	..	..	20	1,338	160	1,662	20	..	255	115	3,150	10
Nelson	5	..	..	..	..	..	..	..	..	200	..	30	..	..	10	20	..	..
Lyttelton	51	..	..	..	..	..	{ New Caledonia .. 1,395 Nauru .. 10,074 Makatea .. 3,067 }	171	25	100	50	..	200	100	..	650	..	..
Timaru	..	..	2	..	..	..	New Caledonia	328	..	5	..	..	80	..	..	..	..	..
Dunedin	16	70	11	25	..	..	{ Nauru .. 3,629 New Caledonia .. 1,610 Makatea .. 3,143 }	50	65	24	25	..	65	390	..	1,196	..	..
Invercargill	35	40	..	..	..	..	New Caledonia	1,548	50	174	25	125	..	136	150	..	..	..

NOTE.—For the previous year's corresponding table see *Journal of May, 1923.*

GOATS AND BLACKBERRY IN PELORUS VALLEY.

A LETTER was received recently by the Department from Mr. A. J. Rush, of Canvastown, Pelorus Valley, Marlborough, intimating that he was successfully controlling the blackberry pest on his farm with goats, and could show paddocks practically clean, and others on which the goats were working or had just been fenced. Mr. Rush's farm has an area of 700 acres, and he keeps 300 goats, both pure and half-bred Angoras. The farm was visited last month by the district Inspector of Stock, Mr. J. G. Scott (Blenheim), who made the following report on the matter in question :-

"Judging from the present condition of this property, and taking into consideration the fact that until goats were used for the purpose of control all the flat and most of the easy country there was completely in possession of blackberry, it cannot be said that Mr. Rush has overstated the case where he says in his letter, 'I have done and am still doing good work with goats.' The position here as regards blackberry cannot be shown better than by simply stating the fact that for the past ten years no cutting or clearing--except in the home paddock, where the goats are too timid to feed--has been carried out, and yet the pest is well under control. As a proof of the latter fact, Mr. Rush is carrying equal to 800 sheep on about 500 acres of pasturage. This is a much higher rate than the average carrying-capacity of the same class of land.

"The use of goats, therefore, has released the owner from carrying out the almost continuous work of clearing, which before the present means was employed was found necessary. To many owners of blackberry-infested country this statement may bear the appearance of being too good to be true. But it must always be borne in mind that results such as Mr. Rush has achieved can be effected only by the use of sound methods, and by good judgment in the management of goats through the maintenance in health of these animals and their proper distribution over the various blocks on the farm; and, last, but not least, by the maintenance of all fences in a goat-proof condition.

"That goats can be successfully used against blackberry and to the extent of completely obviating the necessity of cutting and clearing it in the ordinary way is no new discovery. By the use of these animals many landowners in the Pelorus have been enabled to keep blackberry under control. Where, however, sufficient judgment and care are not exercised it would be idle for such owners to expect any great measure of success. In their cases the old methods of cutting and clearing will continue to be necessary.

"Mr. Rush strongly holds the opinion that all crossbred goats should receive the same measure of protection as is now accorded to Angoras."

Noxious Weeds.—The Mauriceville County Council has declared gorse and pennyroyal to be noxious weeds within that county. Californian thistle has been declared by the Maniototo and the Vincent County Councils and the Otago Heads Road Board not to be a noxious weed within their respective territories; ragwort has been similarly dealt with by Vincent County.

A READY-RECKONER FOR WEIGHT OF FIELD CROPS PER ACRE.

(Concluded.)

TABLE SHOWING WEIGHT OF CROP PER ACRE WHEN THE AREA FROM WHICH THE PRODUCE IS TAKEN IS 1 CHAIN IN 28 IN. DRILLS—EQUIVALENT TO $\frac{1}{28}$ ACRE.

Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.	Weight per Acre.
lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.
1	0 2 2 3	61	7 14 0 15	121	15 5 2 27	181	22 17 1 11
2	0 5 0 6	62	7 16 2 18	122	15 8 1 2	182	22 19 3 14
3	0 7 2 4	63	7 19 0 21	123	15 10 3 5	183	23 2 1 17
4	0 10 0 12	64	8 1 2 24	124	1 13 1 8	184	23 4 3 20
5	0 12 2 15	65	8 4 0 27	125	15 15 3 11	185	23 7 1 23
6	0 14 0 18	66	8 6 3 2	126	15 18 1 14	186	23 9 3 26
7	0 17 2 21	67	8 9 1 5	127	16 0 3 17	187	23 12 2 1
8	1 0 0 24	68	8 11 3 8	128	16 3 1 2	188	23 15 0 4
9	1 2 2 27	69	8 14 1 11	129	16 5 3 23	189	23 17 2 7
10	1 5 1 2	70	8 16 3 14	130	16 8 1 26	190	24 0 0 10
11	1 7 3 5	71	8 19 1 17	131	16 11 0 1	191	24 2 2 13
12	1 10 1 8	72	9 1 3 20	132	16 13 2 4	192	24 5 0 16
13	1 12 3 11	73	9 4 1 23	133	16 16 0 7	193	24 7 2 19
14	1 15 1 14	74	9 6 3 26	134	16 18 2 10	194	24 10 0 22
15	1 17 3 17	75	9 9 2 1	135	17 1 0 13	195	24 12 2 25
16	2 0 1 20	76	9 12 0 4	136	17 3 2 16	196	24 15 1 0
17	2 2 3 23	77	9 14 2 7	137	17 6 0 19	197	24 17 3 3
18	2 4 1 26	78	9 17 0 10	138	17 8 2 22	198	25 0 1 6
19	2 8 0 1	79	9 19 2 13	139	17 11 0 25	199	25 2 3 9
20	2 10 2 4	80	10 2 0 16	140	17 13 3 0	200	25 5 1 12
21	2 13 0 7	81	10 4 2 19	141	17 16 1 3	201	25 7 3 15
22	2 15 2 10	82	10 7 0 2	142	17 18 3 6	202	25 10 1 18
23	2 18 0 13	83	10 9 2 25	143	18 1 1 9	203	25 12 3 21
24	3 0 2 16	84	10 12 1 0	144	18 3 3 12	204	25 15 2 24
25	3 3 0 19	85	10 14 3 3	145	18 6 1 15	205	25 17 3 27
26	3 5 2 22	86	10 17 1 6	146	18 8 3 18	206	26 0 2 2
27	3 8 0 25	87	10 19 3 9	147	18 11 1 21	207	26 3 0 5
28	3 10 3 0	88	11 2 1 12	148	18 13 3 24	208	26 5 2 8
29	3 13 1 3	89	11 4 3 15	149	18 16 1 27	209	26 8 0 11
30	3 15 3 6	90	11 7 1 18	150	18 19 0 2	210	26 10 2 14
31	3 18 1 9	91	11 9 3 21	151	19 1 2 5	211	26 13 0 17
32	4 0 3 12	92	11 12 1 24	152	19 4 0 8	212	26 15 2 20
33	4 3 1 15	93	11 14 3 27	153	19 6 2 11	213	26 18 0 23
34	4 5 3 18	94	11 17 2 2	154	19 9 0 14	214	27 0 2 26
35	4 8 1 21	95	12 0 0 5	155	19 11 2 17	215	27 3 1 1
36	4 10 3 24	96	12 2 2 8	156	19 14 0 0	216	27 5 3 4
37	4 13 1 27	97	12 5 0 11	157	19 16 2 23	217	27 8 1 7
38	4 16 0 2	98	12 7 2 14	158	19 19 0 26	218	27 10 3 10
39	4 18 2 5	99	12 10 0 17	159	20 1 3 1	219	27 13 1 13
40	5 1 0 8	100	12 12 2 20	160	20 4 1 4	220	27 15 3 16
41	5 3 2 11	101	12 15 0 23	161	20 6 3 7	221	27 18 1 19
42	5 6 0 14	102	12 17 2 26	162	20 9 1 10	222	28 0 3 22
43	5 8 2 17	103	13 0 1 1	163	20 11 3 13	223	28 3 1 25
44	5 11 0 20	104	13 2 3 4	164	20 14 1 16	224	28 6 0 0
45	5 13 2 23	105	13 5 1 7	165	20 16 3 19	225	28 8 2 3
46	5 16 0 26	106	13 7 3 10	166	20 19 1 22	226	28 11 0 6
47	5 18 3 1	107	13 10 1 13	167	21 1 3 25	227	28 13 2 9
48	6 1 1 4	108	13 12 3 16	168	21 4 2 0	228	28 16 0 12
49	6 3 3 7	109	13 15 1 19	169	21 7 0 3	229	28 18 2 15
50	6 6 1 10	110	13 17 3 22	170	21 9 2 6	230	29 1 0 18
51	6 8 3 13	111	14 0 0 25	171	21 12 0 9	231	29 3 2 21
52	6 11 1 16	112	14 3 0 0	172	21 14 2 12	232	29 6 0 24
53	6 13 3 19	113	14 5 2 3	173	21 17 0 15	233	29 8 2 27
54	6 16 1 22	114	14 8 0 6	174	21 19 2 18	234	29 11 1 2
55	6 18 3 25	115	14 10 2 9	175	22 2 0 21	235	29 13 3 5
56	7 1 2 0	116	14 13 0 12	176	22 4 2 24	236	29 16 1 8
57	7 4 0 3	117	14 15 2 15	177	22 7 0 27	237	29 18 3 11
58	7 6 2 6	118	14 18 0 18	178	22 9 3 2	238	30 1 1 14
59	7 9 0 9	119	15 0 2 21	179	22 12 1 5	239	30 3 3 17
60	7 11 2 12	120	15 3 0 24	180	22 14 3 8	240	30 6 1 20

TABLE SHOWING WEIGHT OF CROP PER ACRE—*continued.*

Weight per Area.	Weight per Acre	Weight per Area.	Weight per Acre.	Weight per Area.	Weight per Acre	Weight per Area.	Weight per Acre.
lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.	lb.	Tons cwt. qr. lb.
241	30 8 3 23	310	40 6 0 5	397	50 3 0 15	475	60 0 0 25
242	30 11 1 26	320	40 8 2 8	398	50 5 2 18	476	60 2 3 0
243	30 14 0 1	321	40 11 0 11	399	50 8 0 21	477	60 5 1 3
244	30 16 2 4	322	40 13 2 14	400	50 10 2 24	478	60 7 3 6
245	30 19 0 7	323	40 16 0 17	401	50 13 0 27	479	60 10 1 9
246	31 1 2 10	324	40 18 2 20	402	50 15 3 2	480	60 12 3 12
247	31 4 0 13	325	41 1 0 23	403	50 18 1 5	481	60 15 1 15
248	31 6 2 16	326	41 3 2 26	404	51 0 3 8	482	60 17 3 18
249	31 9 0 19	327	41 6 1 1	405	51 3 1 11	483	61 0 1 21
250	31 11 2 22	328	41 8 3 4	406	51 5 3 14	484	61 2 3 24
251	31 14 0 25	329	41 11 1 7	407	51 8 1 17	485	61 5 1 27
252	31 16 3 0	330	41 13 3 10	408	51 10 3 20	486	61 8 0 2
253	31 19 1 3	331	41 16 1 13	409	51 13 1 23	487	61 10 2 5
254	32 1 3 6	332	41 18 3 16	410	51 15 3 26	488	61 13 0 8
255	32 4 1 9	333	42 1 1 19	411	51 18 2 1	489	61 15 2 11
256	32 6 3 12	334	42 3 3 22	412	52 1 0 4	490	61 18 0 14
257	32 9 1 15	335	42 6 1 25	413	52 3 2 7	491	62 0 2 17
258	32 11 3 18	336	42 9 0 0	414	52 6 0 10	492	62 3 0 20
259	32 14 1 21	337	42 11 2 3	415	52 8 2 13	493	62 5 2 23
260	32 16 3 24	338	42 14 0 6	416	52 11 0 16	494	62 8 0 26
261	32 19 1 27	339	42 16 2 9	417	52 13 2 19	495	62 10 3 1
262	33 2 0 2	340	42 19 0 12	418	52 16 0 22	496	62 13 1 4
263	33 4 2 5	341	43 1 2 15	419	52 18 2 25	497	62 15 3 7
264	33 7 0 8	342	43 4 0 18	420	53 1 0 0	498	62 18 1 10
265	33 9 2 11	343	43 6 2 21	421	53 3 3 3	499	63 0 3 13
266	33 12 0 14	344	43 9 0 24	422	53 6 1 6	500	63 3 1 16
267	33 14 2 17	345	43 11 2 27	423	53 8 3 9	501	63 5 3 19
268	33 17 0 20	346	43 14 1 2	424	53 11 1 12	502	63 8 1 22
269	33 19 2 23	347	43 16 3 5	425	53 13 3 15	503	63 10 3 25
270	34 2 0 26	348	43 19 1 8	426	53 16 1 18	504	63 13 0 3
271	34 4 3 1	349	44 1 3 11	427	53 18 3 21	505	63 16 0 6
272	34 7 1 4	350	44 4 1 14	428	54 1 1 24	506	63 18 2 9
273	34 9 3 7	351	44 6 3 17	429	54 3 3 27	507	64 1 0 12
274	34 12 1 10	352	44 9 1 20	430	54 6 2 2	508	64 3 2 15
275	34 14 3 13	353	44 11 3 23	431	54 9 0 5	509	64 6 0 18
276	34 17 1 16	354	44 14 1 26	432	54 11 2 8	510	64 8 2 21
277	34 19 3 19	355	44 17 0 1	433	54 14 0 11	511	64 11 0 24
278	35 2 1 22	356	44 19 2 4	434	54 16 2 14	512	64 13 2 27
279	35 4 3 25	357	45 2 0 7	435	54 19 0 17	513	64 16 0 30
280	35 7 2 0	358	45 4 2 10	436	55 1 2 20	514	64 18 3 3
281	35 10 0 3	359	45 7 0 13	437	55 4 0 23	515	65 1 1 6
282	35 12 2 6	360	45 9 2 16	438	55 6 2 26	516	65 3 3 9
283	35 15 0 9	361	45 12 0 19	439	55 9 1 1	517	65 6 1 11
284	35 17 2 12	362	45 14 2 22	440	55 11 3 4	518	65 8 3 14
285	36 0 0 15	363	45 17 0 25	441	55 14 1 7	519	65 11 1 17
286	36 2 2 18	364	45 19 3 0	442	55 16 3 10	520	65 13 3 20
287	36 5 0 21	365	46 2 1 3	443	55 19 1 13	521	65 16 1 23
288	36 7 2 24	366	46 4 3 6	444	56 1 3 16	522	65 18 3 26
289	36 10 0 27	367	46 7 1 9	445	56 4 1 19	523	66 1 2 1
290	36 12 3 2	368	46 9 3 12	446	56 6 3 22	524	66 4 0 4
291	36 15 1 5	369	46 12 1 15	447	56 9 1 25	525	66 6 2 7
292	36 17 3 8	370	46 14 3 18	448	56 12 0 0	526	66 9 0 10
293	37 0 1 11	371	46 17 1 21	449	56 14 2 3	527	66 11 2 13
294	37 2 3 14	372	46 19 3 24	450	56 17 0 6	528	66 14 0 16
295	37 5 1 17	373	47 2 1 27	451	56 19 2 9	529	66 16 2 19
296	37 7 3 20	374	47 5 0 2	452	57 2 0 12	530	66 19 0 22
297	37 10 1 23	375	47 7 2 5	453	57 4 2 15	531	67 1 2 25
298	37 12 3 26	376	47 10 0 8	454	57 7 0 18	532	67 4 1 0
299	37 15 1 1	377	47 12 2 11	455	57 9 2 21	533	67 6 3 3
300	37 18 0 4	378	47 15 0 14	456	57 12 0 24	534	67 9 1 9
301	38 0 2 7	379	47 17 2 17	457	57 14 2 27	535	67 11 3 12
302	38 3 0 10	380	48 0 0 20	458	57 17 1 2	536	67 14 1 15
303	38 5 2 13	381	48 2 2 23	459	57 19 3 5	537	67 16 3 18
304	38 8 0 16	382	48 5 0 26	460	58 2 1 8	538	67 19 1 21
305	38 10 2 19	383	48 7 3 1	461	58 4 3 11	539	68 1 3 24
306	38 13 0 22	384	48 10 1 4	462	58 7 1 14	540	68 4 1 27
307	38 15 2 25	385	48 12 3 7	463	58 9 3 17	541	68 6 3 30
308	38 18 1 0	386	48 15 1 10	464	58 12 1 20	542	68 9 2 2
309	39 0 3 3	387	48 17 3 13	465	58 14 3 23	543	68 12 0 5
310	39 3 1 6	388	49 0 1 16	466	58 17 1 26	544	68 14 2 8
311	39 5 3 9	389	49 2 3 19	467	59 0 0 1	545	68 17 0 11
312	39 8 1 12	390	49 5 1 22	468	59 2 2 4	546	68 19 2 14
313	39 10 3 15	391	49 7 3 25	469	59 5 0 7	547	69 2 0 17
314	39 13 1 18	392	49 10 2 0	470	59 7 2 10	548	69 4 2 20
315	39 15 3 21	393	49 13 0 3	471	59 10 0 13	549	69 7 0 23
316	39 18 1 24	394	49 15 2 6	472	59 12 2 16	550	69 9 2 26
317	40 0 3 27	395	49 18 0 9	473	59 15 0 19	551	69 12 1 1
318	40 3 2 2	396	50 0 2 12	474	59 17 2 22	552	69 14 3 4

TABLE SHOWING WEIGHT OF CROP PER ACRE—continued.

Weight per Acre.	Weight per Acre.			Weight per Acre.	Weight per Acre.			Weight per Acre.	Weight per Acre.										
lb.	Tons	cwt.	qr. lb.	lb.	Tons	cwt.	qr. lb.	lb.	Tons	cwt.	qr. lb.								
553	69	17	1	7	613	77	8	3	10	673	85	0	2	3	733	92	12	0	15
554	69	19	1	10	614	77	11	1	22	674	85	3	0	6	734	92	14	2	18
555	70	2	1	13	615	77	13	3	25	675	85	5	2	9	735	92	17	0	21
556	70	4	3	16	616	77	16	2	0	676	85	8	0	12	736	92	19	2	24
557	70	7	1	19	617	77	19	0	3	677	85	10	2	15	737	93	2	0	27
558	70	9	3	22	618	78	1	2	6	678	85	13	0	18	738	93	4	3	2
559	70	12	1	25	619	78	4	0	9	679	85	15	2	21	739	93	7	1	5
560	70	15	0	0	620	78	6	2	12	680	85	18	0	24	740	93	9	3	8
561	70	17	2	3	621	78	9	0	15	681	86	0	2	27	741	93	12	1	11
562	71	0	0	6	622	78	11	2	18	682	86	3	1	2	742	93	14	3	14
563	71	2	2	9	623	78	14	0	21	683	86	5	3	5	743	93	17	1	17
564	71	5	0	12	624	78	16	2	24	684	86	8	1	8	744	93	19	3	20
565	71	7	2	15	625	78	19	0	27	685	86	10	3	11	745	94	2	1	23
566	71	10	0	18	626	79	1	3	2	686	86	13	1	14	746	94	4	3	26
567	71	12	2	21	627	79	4	1	5	687	86	15	3	17	747	94	7	2	1
568	71	15	0	24	628	79	6	3	8	688	86	18	1	20	748	94	10	0	4
569	71	17	2	27	629	79	9	1	11	689	87	0	3	23	749	94	12	2	7
570	72	0	1	2	630	79	11	3	14	690	87	3	1	26	750	94	15	0	10
571	72	2	3	5	631	79	14	1	17	691	87	6	0	1	751	94	17	2	13
572	72	5	1	8	632	79	16	3	20	692	87	8	2	4	752	95	0	0	16
573	72	7	3	11	633	79	19	1	23	693	87	11	0	7	753	95	2	2	19
574	72	10	1	14	634	80	1	3	26	694	87	13	2	10	754	95	5	5	22
575	72	12	3	17	635	80	4	1	2	695	87	16	0	13	755	95	7	7	25
576	72	15	1	20	636	80	7	0	4	696	87	18	2	16	756	95	10	1	0
577	72	17	3	23	637	80	9	2	7	697	88	1	0	19	757	95	12	3	3
578	73	0	1	26	638	80	12	1	10	698	88	3	2	22	758	95	15	1	6
579	73	3	0	1	639	80	14	2	13	699	88	6	0	25	759	95	17	3	9
580	73	5	2	4	640	80	17	0	16	700	88	8	3	0	760	96	0	0	12
581	73	8	0	7	641	80	19	2	19	701	88	11	1	3	761	96	2	3	15
582	73	10	2	10	642	81	2	0	22	702	88	13	3	6	762	96	5	1	18
583	73	13	0	13	643	81	4	2	25	703	88	16	1	9	763	96	7	3	21
584	73	15	2	16	644	81	7	1	0	704	88	18	3	12	764	96	10	1	24
585	73	18	0	19	645	81	9	3	3	705	89	1	1	15	765	96	12	3	27
586	74	0	2	22	646	81	12	1	6	706	89	3	3	18	766	96	15	2	2
587	74	3	0	25	647	81	14	3	9	707	89	6	1	21	767	96	18	0	5
588	74	5	3	0	648	81	17	1	12	708	89	8	3	24	768	97	0	2	8
589	74	8	1	3	649	81	19	3	15	709	89	11	1	27	769	97	3	0	11
590	74	10	3	6	650	82	2	1	18	710	89	14	0	2	770	97	5	2	14
591	74	13	1	9	651	82	4	3	21	711	89	16	2	5	771	97	8	0	17
592	74	15	3	12	652	82	7	1	24	712	89	19	0	8	772	97	10	2	20
593	74	18	1	15	653	82	9	3	27	713	90	1	2	11	773	97	13	0	23
594	75	0	3	18	654	82	12	2	2	714	90	4	0	14	774	97	15	2	26
595	75	3	1	21	655	82	15	0	5	715	90	6	2	27	775	97	18	1	1
596	75	5	3	24	656	82	17	2	8	716	90	9	0	20	776	98	0	3	4
597	75	8	1	27	657	83	0	0	11	717	90	11	2	23	777	98	3	1	7
598	75	11	0	2	658	83	2	2	14	718	90	14	0	26	778	98	5	3	10
599	76	13	2	5	659	83	5	0	17	719	90	16	3	1	779	98	8	1	13
600	75	16	0	8	660	83	7	2	20	720	90	19	1	4	780	98	10	3	16
601	75	18	2	11	661	83	10	0	23	721	91	1	3	7	781	98	13	1	19
602	76	1	0	14	662	83	12	2	26	722	91	4	1	10	782	98	15	3	22
603	76	3	2	17	663	83	15	1	1	723	91	6	3	13	783	98	18	1	25
604	76	6	0	20	664	83	17	3	4	724	91	9	1	16	784	99	1	0	0
605	76	8	2	23	665	84	0	1	7	725	91	11	3	19	785	99	3	2	3
606	76	11	0	26	666	84	2	3	10	726	91	14	1	22	786	99	6	0	6
607	76	13	1	1	667	84	5	1	13	727	91	16	3	25	787	99	8	2	9
608	76	16	3	4	668	84	7	3	16	728	91	19	2	0	788	99	11	0	12
609	76	18	3	7	669	84	10	1	22	729	92	2	2	3	789	99	13	2	15
610	77	1	0	10	670	84	12	1	1	730	92	4	2	6	790	99	16	0	18
611	77	3	3	13	671	84	15	1	25	731	92	7	0	0	791	99	18	2	21
612	77	6	1	16	672	84	18	0	0	732	92	9	2	12	792	100	1	0	24

—C. H. Schwass, *Fields Division, Wellington.*

Manurial Value of Burnt Bones.—Bone-char is a good phosphatic fertilizer, containing some 60 per cent. of tricalcic phosphate. The nitrogenized organic matter contained in bones is expelled by the burning, however, and any action which may accrue from the decomposing effect of gelatine is also lost. It is thought that in ordinary bones this decomposing effect helps to make the phosphoric acid (P_2O_5) more available.

SEASONAL NOTES.

THE FARM.

TOP-DRESSING OF PASTURES.

TOP-DRESSING with rock phosphate, Ephos, and other slow-acting fertilizers should now be pushed along. June is also a good month for applying basic slag. Superphosphate will be better used a month or two later

It is not advisable to use raw rock phosphate on land that has been recently limed. The liming reduces the acidity of the soil and makes the already slow-acting phosphate slower still. As a general rule, where lime has been applied superphosphate should be used. Where no liming has been done basic super, basic slag, or mixtures of half super and half rock phosphate may be applied. Where the rainfall is light super or basic super should give best results. In wetter situations basic slag or one of the other mixtures mentioned could be used. In average districts the end of June or early in July will be early enough for these manures. As a rule, it is best not to apply super before July, and in the later districts August is early enough.

The farmer must use discretion as to the quantity of fertilizer to apply. This will depend upon the condition of his pasture. If it has been well treated and appears to be in good heart $1\frac{1}{2}$ cwt. to 2 cwt. should be ample. If, on the other hand, the land has been neglected and the grass and clovers are weak it will pay to apply from 3 cwt. to 4 cwt. per acre. Top-dressing should start at a stage in the life of the pasture when it is still good; if this is done a small quantity applied each year will give better results than a heavier dressing one year and none the next. Pastures should be well tripod-harrowed both before and after top-dressing. It is better to keep stock off the top-dressed area for a week or two after applying the fertilizer, or until there has been a good shower or two.

CULTURAL OPERATIONS.

No opportunity should be lost of turning over any land still required for spring sowings. For such crops as mangolds, carrots, and potatoes autumn or early winter ploughing is most important. In the case of lea land, as long as the weather is fair the plough can generally be kept going, as it requires a considerable rainfall to make such land too wet.

Where the soil is not too wet and cold cereals and tares sown early in June may still make sufficient growth to be useful for spring feeding. A good mixture is $1\frac{1}{2}$ bushels of winter tares to $1\frac{1}{2}$ bushels of oats, barley, or rye-corn, with $1\frac{1}{2}$ to 2 cwt. of superphosphate per acre. Care should be taken not to drill too deeply at this season. The addition of a few pounds of Western Wolths or Italian rye-grass is an improvement.

FEEDING OF FODDER CROPS.

Fodder crops sown in March and April will be now throwing an appreciable amount of feed, which can be judiciously grazed down, care being taken not to poach the soil in wet weather. Special care should be taken with newly-sown permanent pastures; sheep should be kept off them as far as possible, and the grazing should not be so close as to bare the young and tender roots to the frosts.

Roots should, as far as possible, be fed out on fields affected with grass-grub or where the grass requires building up. The tramping of the stock will destroy a great many of the grubs, and the necessary hay will supply a considerable amount of grass seed to build up the pastures. Great care should be taken not to feed out swedes on land intended to be cropped with turnips or swedes during the following season or two. Crops are commonly more or less affected by club-root or dry-rot, and if the roots are fed out on a clean field the latter becomes contaminated, with the result that the succeeding crop is liable to be badly diseased. This does not apply to mangolds or carrots, which are not affected by this disease.

It is advisable if the best use is to be made of roots that they be lifted and stacked in a dry position convenient to the feeding-place. In districts where severe frosts are experienced a covering of straw is necessary. The practice of some farmers of allowing cows access to turnips in the field without furnishing any dry fodder must be strongly condemned. In the feeding of all roots plenty of hay or straw should be given with them.

Where mangolds are grown in large areas for sheep they may be harrowed out. If any old broken-mouthed ewes are available it is a good plan to put them on to eat off the tops before harrowing. The ewes will do quite well on the tops, and having few teeth they will not hurt the bulbs.

Dairy cows should get special attention at this period, as it is the time for their annual recuperation, and unless well treated they cannot be expected to give good returns next season. It is false economy to pinch a cow in the off-season; if there is to be a shortage of feed let it be later when the cow has got rid of her calf and the days are getting longer.

LUCERNE.

Land being prepared for lucerne should be thoroughly limed before the end of June. One ton of crushed limestone (carbonate of lime) or $\frac{3}{4}$ cwt. of burnt lime should prove a suitable dressing.

Where a seed-crop is required next season the stand should at this period receive a top-dressing of quick-acting phosphate such as super, or on the colder and wetter soils a manure containing nitrogen as well as phosphate—for example, blood-and-bone. The periodical liming of lucerne stands is an important factor in prolonging their life.

STUMPING BUSH-BURN PASTURES.

In bush or erstwhile bush districts a profitable occupation for the winter months is stumping. There are many thousands of acres of old bush-burn pasture now sorely in need of renovation, and while much

can be done by top-dressing there can very often be no real improvement till the land has been cleared of stumps, roots, and logs, so that the plough and the mower can be got to work. A notable example is to be seen in many parts of North Auckland where *paspalum* is the predominant grass. If the valuable land now growing mainly rushes and coarse *paspalum* were stumped, drained, and ploughed a good *paspalum* and clover sward could be established and kept in a highly productive condition by judicious mowing, disking, and manuring. Hay and ensilage could then be saved—and winter and spring feed is generally an urgent problem in *paspalum* country.

GENERAL OFF-SEASON WORK.

When weather conditions do not allow of cultivation being carried on there remains an immense amount of work that is really essential for the well-being of the farm. Pastures should be harrowed consistently, with the tripods for preference, except on very light soils, where they are apt to prove too severe. Fences should be carefully inspected and strengthened, new fences erected, gates rehung where necessary, and gateways made up with metal, clinkers, or similar material. The amount of time and energy wasted by teams and herds in negotiating boggy gateways and lanes is quite appreciable.

Open drains should be cleaned out and relevelled, and it is a good plan to substitute covered drains, of manuka, punga, or tiles, wherever possible, in order to obviate the risk of losing stock. Small covered drains are also invaluable for freeing paddocks from excessive moisture without inconvenience to tillage-work. On impervious clay soils, and low-lying alluvial lands in particular, drainage is one of the biggest factors in successful farming.

—*Fields Division.*

THE ORCHARD.

PRUNING OPERATIONS.

ORCHARDS will now be clear of all fruit and in readiness for the commencement of pruning operations, which will take precedence over all other work.

Although pruning of fruit-trees has been practised for many years it is quite safe to assert that there is yet a great deal to learn. It is only by careful study and watching the result of each season's operations that any advancement can be made and the best results obtained. There are general basic principles that should largely govern the action taken by every commercial fruitgrower, whereas in details there is a possibility of a very wide range of action whereby good results may be attained. One has to consider the variety, class of soil, climatic conditions, &c. It is poor practice to accept any given and definitely set line upon which to work.

At the time of planting it is necessary to cut back, in the first place, so as to enable root and top growth to commence on equal terms, and also to enable a good foundation to be established. If this is not done it is quite impossible to expect that trees will be built up of such a character that they will yield large crops of fruit. The crop is the

ultimate aim of every fruitgrower, and he should therefore cut fairly hard for the first two or three years, this will enable him to lay a good foundation. Once this has been obtained the aim should be to prune in such a manner as to steadily build up the tree in the main leaders, while at the same time giving due consideration to the development of its fruiting-wood. To continue pruning a vigorous-growing tree hard after it has obtained fairly liberal dimensions is to delay the fruiting-period. The best practice to adopt after the tree has been built up is that which will maintain an even balance between wood-growth and fruit-bearing. While there are some who neglect to carry out any system of pruning, there are others who carry this important operation to excess on certain kinds of trees after the latter have reached the age when they should be carrying good crops of fruit.

No time should be wasted on any trees which are intended for working over later in the season, beyond heading them off a few inches above the point where it is intended to work them. This can be done at any time after the foliage has fallen, but should not be left too late. Any tree of outstanding merit, such as strong growth, combined with good bearing qualities, freedom from disease, &c., should be carefully noted. From this class of tree any wood for reworking purposes should be taken.

PLANTING.

Where conditions are favourable and the land has been well prepared planting can now be commenced. If the land is at all wet, however, this work is much better deferred until later, as the roots would only become water-logged, and this would hold the trees back in the coming spring. Where trees have been received from the nursery the bundles should be opened, and the trees placed in a trench until the land is in a suitable condition for planting.

MARKETING.

Fruit in store should be closely watched, as there are indications that some varieties are not keeping very well. This applies in the main to fruit not in cool store. All varieties as they mature should be placed on the market. No fruit should be marketed without repacking if it has been in the cases more than a few weeks, as nothing will give buyers a worse impression than to find lines of fruit offered for sale with a proportion of rotten or partly rotten fruit in each case. Growers will be well repaid for the extra amount of labour entailed in repacking.

—*L. Paynter, Orchard Instructor, Christchurch.*

CITRUS-CULTURE.

Although it is not well to anticipate trouble, it is reasonable to expect that some frosts will again be experienced in the citrus-growing districts during the ensuing winter months, and precautions should be taken. The grower should, firstly, ensure against the loss of mature fruit that may be hanging on the trees at the time. It is well, therefore, to take immediate steps to remove all fruit that has reached that stage of maturity which will allow of its being efficiently cured. Further, the precautions should be taken of covering young citrus-trees by means of a rough frame of manuka, or other available

material, made bell-tent fashion over the tree, and covered on the top and at least one side—the sunny side—with scrim or light sacking. These coverings should, if possible, be constructed in such a manner as to allow of their being lifted and lowered as required.

No doubt a number of growers will be desirous of extending their groves by new plantings this season, and also it is possible that entire new areas may be planted in this class of fruit. Final preparation of the land should now receive attention, and be completed before the winter rains set in. The writer is entirely in favour of spring planting of citrus-trees in the Auckland Province, but the land should be thoroughly prepared, and the trees set in position at such a time as will ensure their receiving the benefit of the heavy spring rains.

In the selection of the young trees, it is desirable that the purchaser should see exactly what he is purchasing from the nurseryman, in order that the very best stock may be procured. Only young trees showing vigorous growth and possessing a strong root-system should be placed in a permanent position in the orchard. Due regard should be given to the stocks upon which the various varieties are worked. The sweet-orange stock is the one most preferred at the present time, although there is yet large room for experimental work in regard to the selection of the best class of stock or stocks for planting on the various classes of gum-lands to be found in Auckland Province. Those intending planters who receive their young trees from the nursery during the autumn or winter months should take the necessary precaution of heeling them in in a sheltered position, and keeping them covered from possible danger of frost-injury.

STRAWBERRY-GROWING.

It will generally be found that the soil is in excellent condition to receive strawberry-plants during the earlier part of this month, and those growers who have, for one reason or another, not yet carried out their planting should see that this work is completed at the earliest possible date. As pointed out in previous notes, it is absolutely essential that only strawberries of strains known to be a commercial success should receive the attention of any grower.—

—J. W. Collard, Orchard Instructor, Auckland.

POULTRY-KEEPING.

CARE OF THE BREEDING-HENS.

THE selection of the most desirable hens for the coming breeding season should have been made before this. Indeed, such birds should be receiving special attention in order that they may resume egg-laying as soon as possible, and be in the pink of condition at mating-time. In this connection I cannot urge too strongly the advisability of providing the birds with a free range, preferably on grass runs, wherever possible to do so. In this way they not only secure natural exercise but natural food as well—two great essentials for the maintenance of good health. The birds should be fed and managed in such a way

that while being in a healthy state they are at the same time in a more or less hard, lean condition. Now that they are in a non-productive condition there will be a tendency for them to become overfat, a condition which should be avoided at all costs in the future breeding-hen. Eggs produced from overfat stock may hatch fairly well, but the great danger lies in the difficulty of rearing the chicks. I have frequently been called upon to advise regarding heavy mortality in brooder chicks, only to find that the cause of the trouble could be traced to the overfat condition of the parent stock.

The feeding of the birds intended as breeders, and also after they are mated, is all-important. It will generally be found that stronger chicks are produced from the feeding of a variety of whole grains, such as wheat, oats, maize, &c., for both morning and evening meals. Care must be taken that this is fed in deep litter at all times, so as to induce a maximum of exercise. A chick is made up of many parts. It is therefore essential that the mother hen be provided with a variety of foodstuffs, in order that she may secure and impart to her offspring the elements necessary for the development of a sturdy, vigorous chick. The provision of ample green-stuff should not be forgotten. It is one of the chief foodstuffs for promoting good health, while a liberal supply of fresh water, gravel grit, and crushed oyster-shell are of equal importance. Just before or when the birds are producing eggs for reproductive purposes they should be fed and managed in the most natural manner possible. Any attempt to secure high egg-yields by including in the ration a large proportion of forcing-food such as meat will generally result in weak fertility, poor hatches, and the production of chicks that are difficult to rear.

TUBERCULOSIS.

Tuberculosis—which is usually termed by poultrymen “going light,” or “spotted liver”—is a contagious disease in poultry. It affects both old and young stock, and is no doubt the most serious disease that the poultry-keeper has to guard against, not only owing to its fatal effects, but also owing to there being no curative methods which can be employed to combat it. Most other troubles affecting poultry, especially where the cause is first removed, will yield to some extent to curative treatment; but this one is entirely different, the only effective way of fighting it being to prevent it.

The disease is most common at this period of the year, for the reason that the great majority of the adult stock are in the poorest condition. This is a result of an exhausting laying season, together with the effect of the moulting process, which in itself makes a severe demand on the system of the bird. The present is therefore a time to watch closely for the evils arising from any constitutional weakness in the stock and from improper methods of management; it is now that the birds are in their most susceptible state should they come in contact with the infection. It is thus a mistake to allow the birds to become run down or to neglect them in any way merely because they are not in a laying condition. If they are to have the power to resist disease their health must be as good as possible. Especially should the diet be nourishing and fed with a free hand, and a plentiful supply of green-stuff is imperative. While good feeding and special care and management are important factors in warding off disease, the first

precaution lies in the maintenance of constitutional vigour in the flock. Apart altogether from the value of outstanding vigour for the maintenance of egg-laying, this quality must be present in both males and females if disease is to be kept at bay. No bird, however well it has laid, should be bred from if it gives the slightest evidence of a weakened constitution.

A further valuable precaution is to see that the young stock are reared under the best possible conditions, in order that there may be no check in their development. The poorly reared bird is always susceptible to every passing ailment. In this connection the necessity must be strongly urged of providing a clean run—one that has been spelled for some time, and for preference that has been turned over, well limed, and sown down. It is essential that the quarters be maintained always in a thoroughly sanitary state. This means frequent cleaning, disinfection, and, above all, the avoidance of poultry-sick soil. Overcrowding should also be avoided at all costs, and it is important that the sleeping-quarters be well ventilated without draughts. In addition, the house should be opened up in front and arranged in such a way that the sunlight will penetrate to practically all parts of it. Of course, local conditions must always be taken into consideration in regard to the open space allowed in the front of the house. It should, however, always be remembered that fresh air and sunshine are the greatest enemies of disease and parasitic life. Tuberculosis is most common where the birds are kept in dark, damp, or badly ventilated houses, especially where cleanliness is not strictly observed.

The symptoms of tuberculosis in poultry are a listless appearance and rapid emaciation, usually accompanied with diarrhoea followed by a pale-coloured excrement. The bird shows no inclination to mix with other members of the flock, and when it walks there is generally a limp of one leg. Should there be any indication of the presence of the disease the suspected cases should be isolated and placed in a clean house and run. If any of these birds are subsequently considered to be affected a *post mortem* examination should be made. In a case of tuberculosis the liver, which is the chief organ to become affected, will present a mass of cheese-like nodules or tubercles, varying in size from a pin-head to a pea or even larger. The spleen is sometimes affected in a similar manner. Small nodules may also be found in the lungs and in various parts of the digestive tract.

Any bird showing such symptoms should be promptly killed and the carcase burnt. When it is not convenient to properly burn the dead birds they should be buried deeply, so that they will not be dug up by dogs or when the ground is being worked. This precaution should also be taken with birds that die from any cause. If possible the whole of the stock in the run where the affected birds came from should be removed to fresh quarters, and everything favourable for the development of the disease should be removed, and thorough methods of disinfection resorted to. The run should also be dug over and limed, and the house well sprayed with a strong disinfectant.

As the chief source of infection is through the digestive tract, and as the droppings of an affected bird contain enormous numbers of tubercle bacilli, it will be readily seen how easy it is for food to become contaminated and a healthy bird to become affected. If the disease makes its appearance in a flock the risks of infection may therefore be

minimized by providing all the food in troughs, and by removing these immediately the birds have finished their meal. No food should be fed in the litter until such time as indications point to the disease being stamped out. It is also a good plan to keep the birds confined to the house. In this way the source of infection is not only reduced, but a good opportunity is also afforded for turning the run over and sowing it down as a means of sweetening it.

Prevention is the most effective means of fighting disease in poultry generally. The poultry-keeper who breeds his stock on sound principles, who keeps the houses clean, dry, properly ventilated without draught, and free from vermin, who avoids poultry-sick soil, and who provides the right class of food with a free hand, need have little fear of disease.

—*F. C. Brown, Chief Poultry Instructor.*

THE APIARY.

HIVE ENTRANCES AND STANDS.

PERHAPS at no other season is it so necessary to keep the hive-entrances absolutely free of obstruction as at present. Vegetation during the next few months is rarely dry even in fine weather, and when the bright sunshine of early winter days tempts the bees to a flight the apiarist should see that they run no risk of being caught in long grass, weeds, &c., thereby becoming chilled and losing all power of ever re-entering the hives. By removing such growth from around the hives now the entrances will remain clear for the next few months; and if the ground is treated with a dressing of agricultural salt in sufficient quantity before the spring growth starts there should be no trouble of this sort throughout the ensuing season.

In no case should hives be placed directly on the ground, or the bottom-boards will soon rot and have to be replaced. The hives should stand sufficiently high above the ground to avoid dampness, and it is an excellent plan to stand them on four half-bricks placed one at each corner of the bottom-board. Should the apiary be in a permanent situation, no better plan can be followed than to provide concrete hive-stands. These stands have been used in New Zealand for a number of years, and have saved the users a great deal of labour by preventing the growth of weeds and by affording protection against insect pests. They are comparatively expensive to lay down in the first place, but, being permanent, will remain in position indefinitely. If such stands are adopted the concrete should extend a few inches in front of the alighting-boards, in order to prevent vegetation from growing too close to the entrances of the hives. In all cases the hives should have a slight cant towards the entrances, so as to permit of the water leaving the bottom-boards readily. The presence of moisture will lead to much loss to the beekeeper, besides causing the hives to become sour and foul-smelling.

SHELTER.

With the approach of winter and its frequent rough weather the apiarist should turn his attention to the all-important question of shelter. Even if this provision entails a certain amount of outlay, it

will in the end prove one of the greatest economies. Not only is the danger obviated of having hives blown over and lids removed, with the resultant losses by cold and exposure, but it will be found in the spring that the well-sheltered, warmly situated colonies have wintered not only with a minimum of losses but also with a minimum consumption of stores. The colony which has to winter in a cold exposed situation will have to consume far more honey to keep itself alive than the colony whose compact cluster is unaffected by cold and damp. In the latter case, also, the bees will have a far greater degree of vitality with which to face the strain of spring breeding. Bees require just as much attention and care at the approach of winter as at the beginning of summer, and the careful beekeeper will see that they are treated so that, as far as his hives are concerned, he can regard southerly gales, snowstorms, and severe frosts with equanimity.

SAVING THE WAX.

The annual wastage of wax is very great, and it is safe to assert that if more care were exercised by beekeepers there would be ample for local requirements. No industry can be carried on successfully without ample supplies of raw material, yet beekeepers are annually wasting or destroying by fire large quantities of raw material which should go to cheapen the cost of production and add to the profits of the apiary. There are quite a number of comb-foundation manufacturers in the Dominion, and, to their credit, it may be said that they are on the whole turning out an article quite equal to the imported. Their main difficulty is in obtaining beeswax to carry on, while their customers are disposing otherwise of the raw material which could be converted into foundation. Manufacturers are working up wax into foundation at 8d. to 9d. per pound. This is reasonable when the skill and time necessary to manufacture a good article is taken into consideration. The saving to the beekeeper who has his wax converted is approximately 1s. 6d. per pound, and where increase is desired, or in the case of the less fortunate beekeeper who has to treat for disease, the saving is at once apparent.

After the honey crop is disposed of and the bees are settled snugly in their winter quarters the beekeeper should give attention to clarifying his wax. Where a solar extractor has been used during the summer it will be a simple matter to collect the cakes of wax which have been melted in this manner and reduce them to one or two large cakes; but where any number of combs are to be treated a wax-press is an almost indispensable article in the apiary equipment. For handling wax in large quantities the press now known as the Root wax-press is best. No special building is needed for wax-melting; an ordinary wash-house answers the purpose admirably. A cold day should be chosen for the operation, since nothing excites the bees during the off-season like the smell of hot wax.

Commencing operations, fill the copper half full of water, and when this is heated place the combs—which must have been removed from the frames—in the hot water. Have a strong stand ready to support the wax-press, and inside this place a kerosene heater, so arranging it that the flame comes into direct contact with the bottom of the press. Fill the water compartment of the press with boiling water, which the

heater will now keep boiling, and in the perforated basket of the press place a coarse scrim bag, large enough to reach to the bottom of the basket. The combs in the copper should be stirred with a stick until the wax is all melted, and the contents of the copper—water and wax—should then be ladled into the scrim bag in the press. The top of the bag should now be folded so as to allow one or more of the wooden "followers" belonging to the press to be placed on top of it, and when the screw is placed in position a stream of water and wax will immediately commence to flow from the outlet provided in the press. A kerosene-tin or similar vessel should be placed in position under the outlet.

Two precautions are necessary in using a wax-press. Pressure should at all times be applied with caution. Until the flow from the press slackens the screw should not be turned, and when it becomes necessary to apply pressure this should be done without appreciable effort. The screw should always turn easily. It will be found that if this advice is taken the maximum of wax will be obtained with very little risk to the machine. Another point to be borne in mind is that only a comparatively small quantity of water and wax must be put into the bag at each ladling. It is difficult to estimate exactly how much to treat at once, so much depends on the proportions of wax and water, but on no account attempt to fill the scrim bag at one operation. When the wax and water cease to run from the outlet the bag should be removed and the slum-gum emptied out before the press is required to deal with any more wax.

As the copper will, of course, contain a great deal of water, it is an excellent plan to keep a kerosene-pump in the vessel placed to receive the contents of the press. If this is sunk to the bottom of the vessel it will draw off a great deal of the water, leaving the wax, which will, of course, be on top, untouched. This will result in the wax being gathered in far larger cakes than if several vessels are used. The wax should be set aside to cool as gradually as possible, this being best achieved by covering the tin containing it with corn-sacks or similar material. The gradual cooling helps to clarify the wax. When the cakes are quite cold they should be taken out of the tin and carefully scraped.

The tin should next be washed out and partly filled with clean hot water, the cake of wax replaced, and the whole gradually heated until the wax is once more melted. After this second process the whole should be slowly cooled as before, and when the wax is once more removed and scraped it will have reached its commercial form. The wax-press and copper should be cleansed while still hot. The water should be emptied out of its compartment in the press at once, and the press placed to drain in order to prevent rust. The slum-gum must be gathered up and burnt, and the bag washed and dried for future use.

THE ANNUAL CONFERENCE.

The annual Dominion conference of beekeepers will be held at Christchurch on 4th, 5th, and 6th June. It is expected that delegates from all branches of the National Beekeepers' Association of New Zealand will be present. Papers dealing with various phases of the industry will be read, and in addition demonstrations with beekeepers' appliances will be given.

—E. A. Earp, *Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

THE preparation of land for crops referred to in last month's notes should now receive every attention, specially those areas to be planted in onions, early potatoes, or peas. On well-drained land in the warmer localities these crops are best sown as early as possible in the month of July. On the heavier flat lands care must be taken to avoid unduly hurrying the preparation and planting. Great injury is done by working such land when it is too wet, or planting before it is sufficiently warm.

The seed requirements for the season should also have careful consideration now. Seeds of a kind look very much alike to the casual observer, but the experienced grower and the commercial grower especially know the importance of seeds of a good "strain." Germination is usually good, though often weak, but manures and well-prepared land are wasted unless seeds that are clean and of the best strain are planted. Tomato-seed, for example, varies greatly in strain; it may also be affected with the bacterial "black-stripe" disease, for which there is little remedy. It is not uncommon to come across instances where the best of land has been given every attention and the crop skillfully handled, but the result has been unsatisfactory for this reason alone.

As to varieties, it is best to keep in the main to those which experience has proved suitable to the respective districts, although the progressive grower will always try a little seed of a new variety if it is properly recommended.

Small private gardens are more easily managed and a proper rotation observed if, instead of growing all kinds of vegetables every season, a selection is made. Land that has been heavily manured and has carried winter cabbage, broccoli, and sprouts should during the following season be planted in celery and root crops, to be followed the next year by such shallow-rooting subjects as peas, beans, onions, and salads. It is in this way that very small areas may be made wonderfully productive at the lowest cost of material and labour.

What has been said of seed applies very largely to potato sets: it is worth while going to some trouble to get good stocks, and they should be got without delay. Potatoes for planting are best stored in a *light*, airy place, which will check sprouting; in fact, for the earlier crops they are best spread in a single layer. Stored in this way the sets ripen, and any growth made is strong and stout and in every way desirable.

SUNDRY FRUITS AND NUTS.

There are many kinds of fruits and nuts in short supply, both for private home use and market purposes. Almonds, cherries, chestnuts, currants, figs, filberts, gooseberries, persimmons, quinces, and passion-fruit are some of them. They all deserve the careful consideration of the private grower, and many of them of the commercial grower also. It is not at all uncommon in some parts of the country to come across chestnuts and filberts growing on grassy hillsides with very little attention,

and carrying good crops. Persimmons of good varieties crop well here, and when in proper condition are considered by many to be among the most delicious fruits grown. Any of the foregoing may be planted now on suitable land, except perhaps passion-fruit, which, like some other smaller plants, is best left till later.

FLOWERS, SHRUBS, AND TREES.

During the winter interval it is well to consider plans for the coming season before the memory of the last one fades. There is a tendency perhaps for the planting of annuals to become somewhat stereotyped. A number of such plants are suited to sea-side and inland places, light and heavy land. A closer study of the seed catalogues will reveal many excellent alternative plans. A little less variety would improve many schemes, and nearly all would benefit from a greater use of those quieter foliage and flowering plants—*gypsophila*, for instance—that, although modest in themselves, do so much to blend and harmonize the brighter colours. The popular “Bonfire” *salvia* gave a much enhanced display this season in a garden where it was associated with the small white perennial aster. Results depend on careful planning as much as anything, and the best results are then often obtained very simply. The *zinnia* has been much improved of late, and its rich quiet half-tones are worth the consideration of any one who has a piece of good land to spare in the garden for this purpose.

While detached trees or groups of shrubs on a lawn add much to the interest of a garden and afford variety, the effect is lost if suitable spaces do not intervene. Too often such is not the case, and trees and shrubs are planted with a rather monotonous regularity. Such places may now be adjusted by removing some of the plants together in groups and leaving others in a suitable isolation. Quite large shrubs may be removed with safety at this season if the work is properly carried out. It is necessary to have a well thought-out scheme before commencing the work.

Any further planting of trees and shrubs may now be carried out as long as the ground is sufficiently dry, in which case they can hardly be planted too firmly. Avoid crowding the better class of shrubs; the evergreens necessary to create an environment, however, may very well touch and blend. The present is a suitable time for any pruning necessary among ornamental trees and shrubs; this attention is too often neglected in the home garden. A specimen conifer is allowed to develop a double lead until it is almost too late to remove it, or grosser shrubs are allowed to overgrow the better kinds. Most flowering-shrubs would be improved by thinning out the more crowded branches.

—W. C. Hyde, *Horticulturist*.

Registration of Stallions.—A draft Bill providing for the inspection and registration of stallions, prepared by the Department of Agriculture, has been approved by the Board of Agriculture and recommended for enactment this year. The Minister of Agriculture hopes it will be found possible to deal with the Bill during the coming session.



SPECIMEN OF NEW ZEALAND APPLE-EXPORT LABEL, SEASON 1924.

The large figures on right are the broker's registered number and those on left the grower's. The small figures in lower right corner denote the number of apples packed in case. The label is coloured and fits the end of the bushel case.

Wheat and Oats Threshings—Returns of actual threshings up to the end of March received by the Government Statistician from threshing-mill owners showed that until then 3,067,790 bushels of wheat and 1,227,444 bushels of oats had been threshed out. The average yields per acre in cases where particulars of areas were furnished (covering 99 per cent. of total threshings) worked out at 24.55 bushels for wheat and 31.42 bushels for oats. The figures for the Canterbury and Otago Land Districts respectively were as follows: Canterbury—Wheat, 2,563,102 bushels threshed, averaging 25.18 bushels per acre; oats, 517,520 bushels threshed, averaging 27.20 bushels per acre. Otago—Wheat, 374,259 bushels, averaging 21.78 bushels per acre; oats, 331,668 bushels, averaging 36.96 bushels per acre.

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 10th May: *Peas*—Consumptive demand better for all descriptions of blue. Present values are—Japanese on passage, £21 10s. per ton c.i.f.; April-May shipments, £20. Small Baltic April-May shipments, £20. Dutch hand-picked, April-May shipments, £21 10s. Tasmanian on passage, £20; April-May shipments, £18 10s.; spot selling at £21 10s. to £22 ex store. New Zealand spot nominally £17 to £19. Supplies of maple plentiful, and New Zealand excessive. English selling at 55s. per quarter. New Zealand offered at 70s. to 80s. Tasmanian best, 85s. to 90s. ex store. *Beans*—Market quiet, with fair trade for choice winter and spring crops at 49s. 6d. and 60s. per quarter. Small round, 70s. to 75s.

WEATHER RECORDS: APRIL, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE month of April opened with dull, misty, and foggy weather, with the barometer reading about normal in all parts of the Dominion. Without change in this respect a deluge of rain fell in several parts of the North Island on the 3rd. A newspaper reported that the River Puhoi rose 16 ft. in an hour. There were also heavy falls of rain in Taranaki, Waihi, Auckland, and along the Wanganui River. Further heavy falls took place between the 4th and 8th, when the barometer was at its highest—30.58 in. at Wellington.

Fair weather prevailed for a short time, but the barometer fell smartly in the South on the 10th, and was followed by showery conditions in the west coast and southern districts until the 14th. Variable breezes and fair though somewhat changeable skies were experienced until the 22nd, when a westerly storm-area made its appearance, bringing heavy rain in Westland and Otago. Rainy weather followed in the North next day, with strong northerly winds. A rather sudden but mild southerly on the 24th accounted for a temporary improvement, but the closing days of the month were unsettled and stormy, especially in and southward of Cook Strait.

The rainfall was generally above the average, but deficient in North Canterbury, and the temperatures were mild for the season.

—D. C. Bates, Director.

RAINFALL FOR APRIL, 1924 AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average April Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitia	6.62	16	1.36	3.55
Russell	5.37	16	0.87	3.39
Whangarei	9.65	19	2.11	4.95
Auckland	11.56	19	4.32	3.34
Hamilton	9.52	20	2.82	3.64
Kawhia	7.66	12	1.82	4.75
New Plymouth	8.29	14	2.34	4.57
Inglewood	11.99	16	2.82	8.39
Whangamomona	14.68	14	4.00	6.68
Tairua, Thames	20.38	16	6.00	5.88
Tauranga	9.23	18	2.05	4.47
Maraekakaho Station, Opotiki	5.56	14	1.76	5.22
Gisborne	5.35	12	1.79	4.26
Taupo	5.94	14	2.54	3.95
Napier	3.05	8	1.35	2.17
Maraekakaho Station, Hastings	2.86	15	1.01	3.14
Taihape	4.10	14	1.32	3.37
Masterton	2.08	11	0.51	3.18
Patea	5.14	11	1.28	3.95
Wanganui	6.55	8	3.51	3.59
Foxton	3.27	9	0.86	2.57
Wellington	2.73	8	1.07	3.84
<i>South Island.</i>				
Westport	9.15	16	1.55	6.50
Greymouth	9.17	19	2.14	8.83
Hokitika	21.22	19	4.68	9.31
Arthur's Pass	24.08	11	8.90	17.64

RAINFALL FOR APRIL, 1924—continued.

Station.	Total Fall	Number of Wet Days.	Maximum Fall.	Average April Rainfall.
<i>South Island—continued.</i>				
	Inches.		Inches.	Inches.
Okuru, Westland	23.46	16	8.00	13.67
Collingwood	9.96	15	2.22	8.07
Nelson	5.92	12	2.40	2.93
Spring Creek, Blenheim	2.95	10	2.08	1.91
Tophouse	7.76	9	2.21	4.03
Hammer Springs	4.21	8	1.40	3.27
Highfield, Waiau	1.01	6	0.43	2.85
Gore Bay	0.46	6	0.17	2.02
Christchurch	0.76	9	0.35	1.91
Timaru	1.90	8	1.08	1.49
Lambrook Station, Fairlie	3.94	6	2.26	2.00
Benmore Station, Omarama	5.62	10	2.55	2.52
Oamaru	0.85	5	0.38	1.76
Queenstown	5.62	13	1.08	2.92
Clyde	3.26	10	1.68	1.34
Dunedin	1.96	7	..	2.72
Gore	2.11	13	0.47	3.26
Invercargill	2.96	17	2.22	4.43

IMPORTATION OF FERTILIZERS: MARCH QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the quarter ended 31st March, 1924: *Sulphate of Ammonia* United Kingdom, 81 tons; Australia, 61 tons; total, 142 tons. *Nitrate of Soda*: Chile, 40 tons. *Basic Slag and Thomas Phosphate*. United Kingdom, 6,847 tons; Belgium, 1,155 tons; Netherlands, 10 tons; total, 8,012 tons. *Bonedust*: India, 310 tons; Australia, 624 tons; total, 934 tons. *Guano and Rock Phosphate*: United Kingdom, 5 tons; New Caledonia, 1,198 tons; Nauru Island, 13,165 tons; total, 14,368 tons. *Phosphates, other*: United Kingdom, 10 tons. *Kainit*: United Kingdom, 199 tons; Germany, 210 tons; total, 409 tons. *Sulphate of Potash*: United Kingdom, 50 tons; Germany, 83 tons; total, 133 tons. *Potash, other*. United Kingdom, 30 tons; Germany, 25 tons; total, 55 tons. *Sulphate of Iron*: Australia, 34 tons.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* for 17th April and 1st May, 1924, include the following of agricultural interest:—

No. 48018: Cream-separator; L. Rasch, Christiania, Norway. 49800: Flax-treatment; W. F. Lietz, Auckland. 50126: Frozen-carcase transferring and bagging means; S. H. Higgs and E. P. O'Donnell, Wellington. 50276: Milk-agitator; L. H. Clapham, Tokomaru. 49139 and 50499: Cow-milker; E. H. Wright, Morrinsville. 50523: Sheep-shear; F. G. W. Bristow, Sydney. 51471: Cream, &c., pasteurizing; J. O'Connell and H. H. Kerr, Kensington, Vic. 51563: Milk or cream cooler; J. D. Hunter and J. Moore, Dunedin. 51566: Horse shoeing and treating apparatus; F. A. Kerr, Auckland. 51660: Cattle-injection apparatus; A. Coombes, Mataura. 51741: Cream-cooler; E. D. Berry, Palmerston North.

Copy of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington, price 1s.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

SHEEP ATTACKED BY BLOW-FLY.

PALMER BROS., Whangamata :—

I should be glad if you would inform me whether there is a reliable dressing which will prevent blow-flies from attacking sheep. We have a few stud merinos, and in spite of every attention the flies will not leave them alone. We have tried preparations, but without any good results.

The Live-stock Division :—

There is no known dressing which when applied will act as a permanent remedy against the attacks of blow-fly. Any dressing applied must be repeated at intervals, especially in wet weather, as a damp condition of the wool attracts the fly. Attention to the wool of the hindquarters—crutching if necessary—is essential. As a preventive of the fly “striking,” probably the best results follow spraying or saturation with a solution of dipping-powder, taking care that the dip reaches to the skin by using a powerful spray-pump. The sheep should be examined again in a few days, in order to destroy any maggots which may have escaped. The sheep should be kept away from sheltered, shady places, where, as a rule, the fly is more prevalent.

ERADICATING YARROW BEFORE LUCERNE.

A. H. ROWE, Tauranga :—

Would you kindly indicate the best method of eradicating yarrow in an area intended for lucerne; or would the lucerne be able to combat the intruder if sown in the autumn? The spring-tooth cultivator will not bring the yarrow to the surface after fallowing for two months, the root being too soft and brittle.

The Fields Division :—

Yarrow is a hardy strong-growing weed, with a deep taproot, so that it hardly seems likely that the lucerne would make headway against it. The first step in eradication is deep ploughing, followed by the cultivator and tine harrows immediately after, while the soil is loose. Roll the yarrow up with the chain harrows and cart it off, repeating the operations till the paddock is clean, finally going over the ground and picking out by hand any plants remaining. If you have no time to do this at present, fallow this month with persistent cultivation, and grow next season mangolds, potatoes, or maize, which should be thoroughly cleaned by intercultivation and hand-hoeing. As regards autumn sowing, you would probably find that the yarrow did more growing in the winter than the lucerne.

BROKEN-WINDED HORSES.

H. H. W., Waiomiko :—

About six months ago one of my draught horses developed a nasty dry cough and became very thick in the wind, and now he can scarcely work at all; even when he is not doing anything his sides heave like a horse that has just finished a heavy pull. Another horse started to go exactly the same about three months ago, but besides the cough he runs at the nose a good deal. I grow and cut my own chaff, but last season, on account of the wet weather, the oats were badly damaged before we could get them harvested, with the result that the chaff was dusty and musty. I fed it to the horses with maize, and they ate it quite all right. I will be much obliged if you will tell me the cause of the trouble and what to do for the horses.

The Live-stock Division :—

Your horses are apparently suffering from broken wind—the result of improper feeding. When this trouble is well established little can be done to cure it, but proper attention to feeding will alleviate the symptoms. The animals should be fed fairly frequently and in small quantities, so that overloading of the stomach is prevented. Any hay which is fed should be thoroughly clean and free from dust, and should be dampened before use and preferably fed from the floor. See that they are watered before feeding. As irregularity in the action of the bowels frequently accompanies this condition, it would be as well to give a dose of raw linseed-oil two or three times a month.

LIMING FOR WESTLAND SOILS.

T. STONE, Puketoi :—

In reference to the article on page 28 of the *Journal* for January last, concerning the liming of Westland soils, I would be glad to know whether raw ground limestone is meant or burnt limestone

The Fields Division :—

In all cases recorded in the article, excepting the Westport district, ground burnt lime was used. In Westport slaked burnt limestone was used, there being no machinery at the local lime-kilns for grinding purposes. Under this method the limestone after being burnt is put out on the field in small heaps, allowed to air-slake, and is then spread on the land. It has practically the same action as ground burnt lime. Raw ground limestone (carbonate of lime) has been procurable in Westland only during the past twelve months, where used it is giving very satisfactory results.

CONTAGIOUS VAGINITIS IN COWS.

C. D. F., Ormondville :—

A number of my cows are affected with vaginitis, and with the exception of one I believe them to be in calf. I am treating them as advised in the *Journal* for April, 1923. Is it any use treating in-calf cows, or is the flushing of the passage likely to cause them to slip? Is it correct that a yellowish discharge should come away after washing? Will an affected cow sometimes carry her calf the full period, or is she likely to slip at any time or only during the first two months? My eighteen-months in-calf heifers are also affected. Is it wise to treat them?

The Live-stock Division :—

So long as symptoms of the trouble persist it would probably be advisable to continue with the treatment. Do not, however, insert the tubing too far or make your material too strong, or you might induce straining. With regard to the discharge you mention, this is not always present. Affected cows may carry their calves to the full time, and do not always slip. We should advise you to treat your heifers also.

GROWING GLADIOLUS FROM SEED.

O. W. GREEN, Tarakohe :—

Would you please let me know whether *Gladiolus* will grow from seed, and the best method to plant same?

The Horticulture Division :—

Gladiolus grows readily from seed. The seed should be kept until the spring, when it may be sown in seed-boxes or a sunny border outside. Seedlings usually flower in two or three years' time.

CONSOLIDATED INDEX OF THE JOURNAL.

ATTENTION is drawn to the publication of a consolidated index of the *New Zealand Journal of Agriculture*, covering the first ten years—twenty half-yearly volumes—June, 1910, to June, 1920. There has been a considerable demand for such an index, and it will be found very useful for reference and other purposes. The index, which is the same size as the *Journal* (royal octavo) and comprises 60 pages, may be obtained on application to the Publisher, Department of Agriculture, Wellington, price 2s. (remittance with order).

PAN-PACIFIC FOOD CONSERVATION CONFERENCE.

THIS conference, to be held under the auspices of the Pan-Pacific Union, at Honolulu, from 31st July to 14th August, 1924, will comprise the following groups: (1) International Agreements regarding Fisheries; (2) Economic Entomology; (3) Plant Pathology; (4) International Quarantine Policies; (5) Crop Production and Improvement; (6) Forestry; (7) Climatology; (8) Transportation and Distribution of Food Products; (9) Topography—Land and Sea; (10) Animal Husbandry.

It will be seen that the range of subjects is very comprehensive, and includes most branches of knowledge which are of vital interest to New Zealand producers and to those engaged in giving scientific advice. The Director, Mr. A. H. Ford, is anxious to obtain papers to be read before the conference in ample time to have them printed for circulation at the meetings. The chairman for New Zealand, Mr. B. C. Aston, P.O. Box 40, Wellington, will be pleased to receive the titles of any papers which authors may wish read or the papers themselves.

FORTHCOMING WINTER SHOWS.

Southland A. and P. Association: Invercargill, 21st to 23rd May.

Waikato Winter Show Association: Hamilton, 27th May to 3rd June

Otago A. and P. Association: Dunedin, 3rd to 6th June.

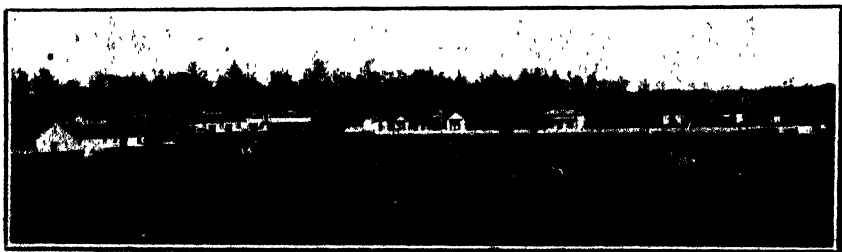
Auckland Winter Exhibition: Auckland, 10th to 28th June.

Manawatu A. and P. Association: Palmerston North, 17th to 20th June.

Wellington Winter Show Association: Wellington, 5th to 12th July.

(Agricultural and Pastoral Association secretaries are invited to supply dates and location of their shows.)

Winter Farm-schools.—Enrolments for the school to be held at Dargaville from 30th June to 4th July are to be made with Mr. A. R. Valder, Mangawhare, Northern Wairoa—not with the Instructor in Agriculture, Auckland, as stated last month.



HOMESTEAD, ETC., AT CENTRAL DEVELOPMENT FARM, WERAHOA.



The New Zealand Journal of Agriculture.

VOL. XXVIII.—NO. 6.

WELLINGTON, 20TH JUNE, 1924.

IRRIGATION AND ITS PRACTICE.

(Continued.)

III. METHODS OF APPLYING WATER AND PREPARATION OF THE LAND

R. B. TENNENT, N.D.D., Instructor in Agriculture, Dunedin, and J. R. MARKS, A.M.Inst.C.E., M.N.Z.Soc.C.E., Resident Engineer, Public Works Department, Alexandra.

THERE are three main principles under which the natural moisture content of soil may be artificially supplemented for the improvement of plant-growth. These are (1) sub-irrigation; (2) standing water; (3) surface irrigation. (Fig. 19.)

The first principle is likely to have so little bearing on the purpose of these articles that it will be dismissed with a few brief remarks. The second, though not at all likely to be purposely attempted in Central Otago, has already come about in some measure as the unavoidable result of surface irrigation, and no doubt it will continue to be the inevitable complement of the latter principle. It comes in between the questions of surface irrigation and drainage (with which the writers will deal at a later date), and must therefore be given something more than a transitory place in these discussions. The third principle embodies the vital subject-matter of this series of articles, and will be dealt with by the writers in considerable detail.

SUB-IRRIGATION.

This principle of irrigation consists in adding water to the soil by injecting it at intervals into the subsoil through buried pipes under low pressure. The pipes are either porous or have a series of holes bored in their upper side. Instead of relieving the soil of some of its moisture, as is done by the well-known system of field-tile drains, extra water is introduced into the soil. It has been proved to be fairly efficient, but careful experiments have shown that no other artificial method is as highly productive per unit of water used as surface irrigation. Sub-irrigation would generally prove prohibitive in initial cost, and might only be used in very small plots where the object is the propagation of rare and valuable plants or seed, in connection with which the introduction of foreign plants or weeds, through the medium of water applied to the surface, might render the desired object futile. The principle is sometimes applied to bowling-greens where it is desired to add moisture without even temporarily saturating the surface.

STANDING WATER.

Under every unirrigated piece of land there is a certain depth below which the subsoil is in a state of permanent and complete saturation. In other words, free water lies at this depth in all the interstices, and if a well were sunk into it the water would rest at this level, known as the ground-water level. This level is fixed by the balance which is struck between natural inflow of water to the subsoil from rainfall and the outflow through natural drainage facilities to rivers and lakes. In low river-flats the ground-water level is likely to be sufficiently near the surface to keep the soil and subsoil, within range of the plant-roots, sufficiently moist for vigorous plant-growth. In such cases irrigation would not be required.

In higher terraces the ground-water level is generally too deep under to be of use to plants. It would in some circumstances be possible, but probably not economical, to permanently raise the ground-water the desired amount, by constructing weirs in the river or stream which controls the ground-water level. However, the same effect is frequently brought about quite unintentionally on low areas with inferior subdrainage by the surplus irrigation water which has been applied to higher adjacent areas. This surplus water percolates through the subsoils to the lower areas, giving a greater inflow than their natural drainage facilities can cope with. These lower areas may have been too dry to be of much use in their previous natural condition; but the result may be that the ground-water level is raised permanently (in some parts probably even too high, causing swamps and necessitating expensive drainage), and always in such cases there will be a certain strip of land, between the surface-irrigated area and the area requiring draining, in which the ground-water level has been raised about the necessary height to bring the moisture content in such strip to something approaching ideal requirements. This strip of land is thus benefited under the principle of "standing-water irrigation."

The drainage-works which have to be carried out in respect to the overwetted areas, if scientifically designed and controlled, will lower the ground-water level again by just the correct amount to enable these swamped areas also to be benefited—or, rather, irrigated—under the

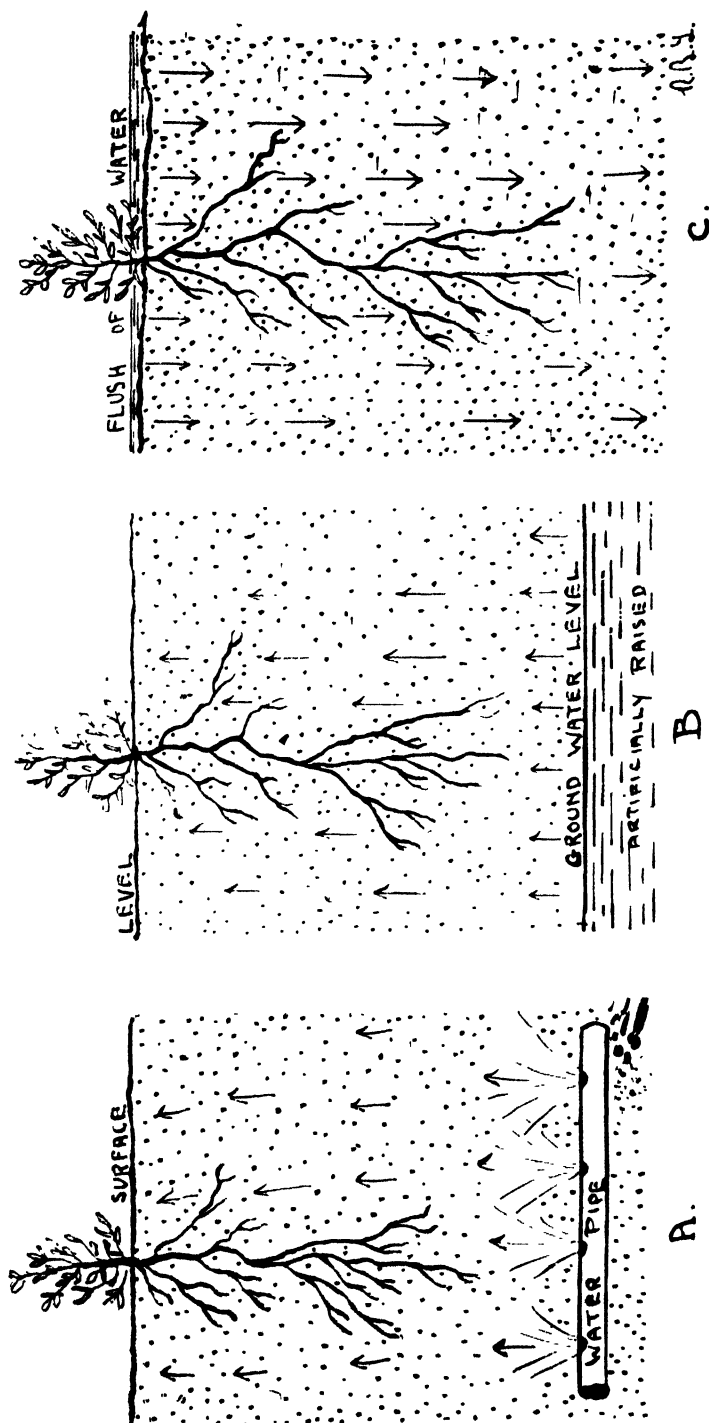


FIG. 19. DIAGRAM ILLUSTRATING THE THREE MAIN PRINCIPLES OF IRRIGATION.

a. Sub-irrigation: Water rising by capillary attraction after occasional injections from buried pipes.

b. Standing water: Water rising continually, entirely by capillary attraction.

c. Surface irrigation: Water passing downward by gravity and capillary attraction during application of flushes to surface. Between flushes it returns upwards by capillary attraction.

[Original.]

standing-water principle. In this manner a condition of affairs arising out of surface irrigation on the higher lands, which may at first sight appear to be a decided offset to the benefits derived from the irrigation of such higher lands, can, if properly dealt with, be converted into a twofold benefit. Just as it devolves upon the engineer to turn this threatened defect into a blessing with respect to a whole valley-bottom, so, in a smaller measure, can the irrigation farmer benefit by the study and application of the principle of standing-water irrigation, allied with his problems of drainage where such may exist.

Generally in Central Otago the subdrainage is so free that not much benefit can be derived from the principle of standing-water irrigation, but in Ida Valley it is already apparent to a marked degree, and in that locality it is quite obvious that several thousands of acres along the valley-bottom may be reclaimed into first-class land by a system of controlled drainage and regulation of the ground-water level.

Before passing on from this principle of irrigation it should be remembered that, once properly established, it has an advantage over the principle of surface irrigation, by being free from the cost of making and maintaining irrigation-ditches and levelling the land, and from the fact that practically no labour is required in its application.

SURFACE IRRIGATION.

This principle, which is the one more generally practised throughout most irrigation districts of the world, consists of adding moisture to the soil by intermittently spreading or running water over its surface. From centuries of practice it has developed into a distinct branch of agricultural science. It has many variations of application, but before dealing with these it would perhaps be interesting to touch upon the problems which faced mankind, and have to a large degree been solved, in arriving at the present period of advanced knowledge.

In the history of irrigation development the problems of applying water to the land seem to have been fairly satisfactorily solved in respect to the two extremes of conformation—namely, hillsides and almost dead flats—long before any satisfactory methods of dealing with the intermediate gradients were evolved. A reasonable explanation of this can be found in a consideration of the natural association of both these extreme classes of country. In hilly land the frequent divisions of the watersheds by ridges prevents the accumulation of rainfall into anything but very small streams, or, if larger ones exist, they are usually in deep inaccessible gorges. The small streams were easily led round the hillsides in small contour ditches, and, being caused to overflow, trickled readily down the steeper slopes and watered considerable areas before being entirely absorbed by the soil. This method still remains in use under the name of "flooding from contour ditches" (Fig. 20), and is still highly recommended; it is, in fact, the only practical way for irrigating steep slopes.

Where the land below the foothills merges into gently falling plains, as is usually the case, the small streams of water, if discharged from contour ditches as described, would travel too slowly over the surface, and would undoubtedly be found to percolate into and through the subsoil before benefiting large enough areas to warrant the trouble involved. The development of irrigation on these moderate slopes

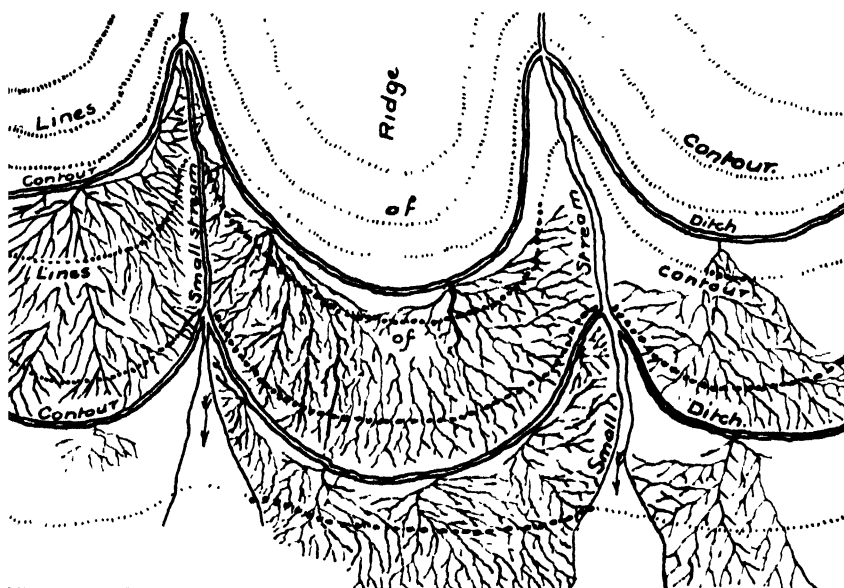


FIG. 2C. SKETCH SHOWING PRIMITIVE METHOD OF IRRIGATING STEEP HILLSIDES BY (CONTOUR DITCHES FROM ADJACENT SMALL STREAMS

[Original.

was therefore delayed until time and the necessities of increasing populations caused industry and intelligence to be brought to bear on the subject, and, as a result, some of the modern and now most universally adopted methods of application were evolved.

On the other hand, prior to the irrigation of the moderate slopes, and possibly before the irrigation of hillsides, very flat plains were irrigated. Here again is evidence of nature being easily adapted. Very flat plains are generally associated with large sluggish rivers, often requiring very little obstruction to raise them so that waters might readily be diverted on to the flat lands. In such cases vast quantities of water were usually available, and, from their very vastness, would readily spread over huge flat areas without further effort on the part of man. This uncontrolled method is practically what is now known as "wild flooding" (Fig. 21).

But here again any plain with even a very moderate slope was found to give difficulties, in that the large flow of water, if not checked by levees or borders of raised earth and subdivided and spread by specially designed ditches and furrows, would peruse a mad course back to the river, watering only a comparatively narrow strip of land, and as likely as not washing away the soil. Until economical solutions were found for the design and construction of methods of control, the irrigation of these moderate slopes was again delayed, as in the case of irrigation by small streams from contour ditches.

Irrigation practice in Central Otago, with a few exceptions, is not yet very far advanced from the primitive methods referred to. There are very few places where dead-flat plains exist (most of the plains having quite considerable gradients), and most of the larger streams or rivers are cut too deeply into the plains to permit of large quantities of water being easily diverted. Consequently it is not surprising that wild flooding was practically non-existent among the many small irrigation projects of the pioneer irrigators. The numerous small streams with which the foothills abound attracted their attention, with the result that almost all the older irrigated lands of Central Otago are on hillsides, and are irrigated by the contour-ditch method. There are, however, one or two instances of wild flooding, the most noticeable being on Mr. J. Lethbridge's property at Ardour.



FIG. 21. WILD FLOODING.

In more recent years Government irrigation schemes have provided for the supply of water upon a much larger scale, and largely to the intermediate plains of moderate slope. Many of the settlers are, unfortunately, endeavouring to irrigate by one or other of these primitive methods lands which are neither flat and even enough for wild flooding nor steep enough for contour ditches. They are using more water than is economical or good for the land, and involving themselves in an extreme amount of unnecessary labour. In making this statement it is not intended to belittle the intelligence of these settlers, who are mostly inexperienced in irrigation, and until recently had only the examples of the older irrigation to be guided by. Some of them have, in fact, brought considerable intelligence to bear upon the situation, and have unconsciously adopted methods closely approaching some of the more modern systems; but too frequently they have not adopted the most efficient method for their particular areas. They should

realize that in attempting to evolve methods of their own they are wasting time, trouble, and expense. They are going over old problems which have been solved in older countries by previous generations of men whose knowledge, gained by trials, failures, and successes, is available to any one who will spare a few hours to read and study the many excellent works on irrigation now obtainable. Instead of delving in the dark, new irrigation settlers should carry on from the point reached by others and devote their energies to further improvements in methods.

It is admitted that the new settler placed upon a bare plot of land, without fencing or building, has his side of the question. He has to put labour and money into his section for some time before he can get a return. Meantime he has to live, and it is quite understandable that his first inclination is to irrigate his land, in order to produce something, by any method, or lack of method, so long as it will make something grow quickly and without much initial cost in preparing the land. In some circumstances he may be justified in starting by roughly irrigating most of his farm by any crude method, with the final object of going back over it later to redevelop upon more efficient lines. However, he should avoid laying down fields in permanent crops on any but the most efficient lines.

METHODS OF SURFACE IRRIGATION.

There is some diversity in the nomenclature of some of the recognized methods, but the writers propose to enumerate the principal ones, and later describe and comment upon them under certain designations, which will be adhered to throughout these articles

For general field irrigation the following list enumerates six of the principal methods, arranged in their order, with relation to the steepness or gradient of the lands upon which they are, in the opinion of the writers, generally most suited for adoption (commencing with the steepest lands): (1) Flooding from contour ditches; (2) flooding from field laterals; (3) the border-ditch system; (4) the border-dyke system; (5) the basin-check method; (6) wild flooding.

The first and last of the foregoing are the primitive methods which, as already explained, appear to have first suggested themselves to man, while the intermediate ones are the outcome of centuries of practice. While no one of them is entirely condemned under its most favourable conditions, it is intended to suggest the circumstances under which each might most economically and efficiently be employed. In these suggestions it will be found that the degree of gradient of the land is generally taken as the principal factor in deciding which method should be adopted. There is no doubt that the texture of the soil, its power to resist erosion, and its degree of porosity must have some bearing upon the matter. Also, the volume of flow of water which the irrigator may have at his command should influence the selection of a method or a modification of the same, as would also the class of crop to be grown. But these are minor considerations as compared with the general one of gradient, and the writers therefore believe that the intelligent irrigator will, from the remarks about to be made, be able to modify the general recommendations to conform with the particular characteristics of his own fields. It should be added that the writers

have in view mainly the irrigation of pastures and permanent fodder and hay crops, and to some extent cereal crops.

Time and further experience may eventually cause the writers to modify or alter their views in some degree, but it is here perhaps appropriate to state that the recommendations about to be made are based upon their personal observations, much study of the subject, and a very intimate knowledge of conditions in Central Otago, for which district their recommendations are essentially designed.

For orchard-work, market-gardening, and certain field crops a further method known as "furrow irrigation" is frequently used; and for several classes of production one or two other methods, involving the reticulation of the water through pipes, will be referred to under the general heading of "pipe irrigation." These will be dealt with in a later article.

Flooding from Contour Ditches.

The general principles of this method have already been referred to. Fig. 22 shows a field laid out for irrigation on these lines. The distributory ditches or furrows follow very nearly the contours of the land. It is the only method which can be recommended for very steep land, and is quite efficient for any slopes of 3 ft. per chain or steeper. Slopes as steep as 30° are frequently in evidence in Central Otago growing clover and grasses well under this method. It can be used for flatter slopes than 3 ft. per chain, but becomes uneconomical, in duty of water and labour costs, as against other methods. It has the inconvenience of many furrows or contour ditches placed irregularly about the land, but, as the steep lands upon which it is recommended are usually only capable of being used for grazing purposes, this does not matter much. These steep lands usually grow very sweet grasses, and, no matter how steep or rough-looking, every part of them should be utilized by the irrigation farmer.

The chief point for caution is to make the contour ditches small, so that it is impossible for a large flow of water to concentrate and cause damage. One good plough-furrow should usually suffice, and the flow of water used should be between $\frac{1}{8}$ cusec for very steep land and $\frac{1}{2}$ cusec on the easier slopes. The gradient of the contour ditches should be kept fairly low (say, about 6 in. of fall per chain), so that the water may easily be made to overflow from them in many places at once. The distance between contour ditches should be in the vicinity of 2 chains, and the distance which water is run along any contour ditch should not exceed about 5 chains; that is to say, the supply-ditches should be about 10 chains apart and contour ditches run each way from them. Using contour ditches of too great length will involve unnecessary loss of water on the way. The supply-ditches, which are directed straight down the steep hill, must be stone-pitched or constructed of wooden or iron fluming to prevent erosion. However, being very steep, these supply-ditches need only be of small dimensions. Sheets of ordinary corrugated galvanized iron placed end for end with a short overlap, and bent sideways into semicircles, form good protection in supply-ditches. Sometimes a natural flat-bottomed gully is used as a supply-ditch, the water being

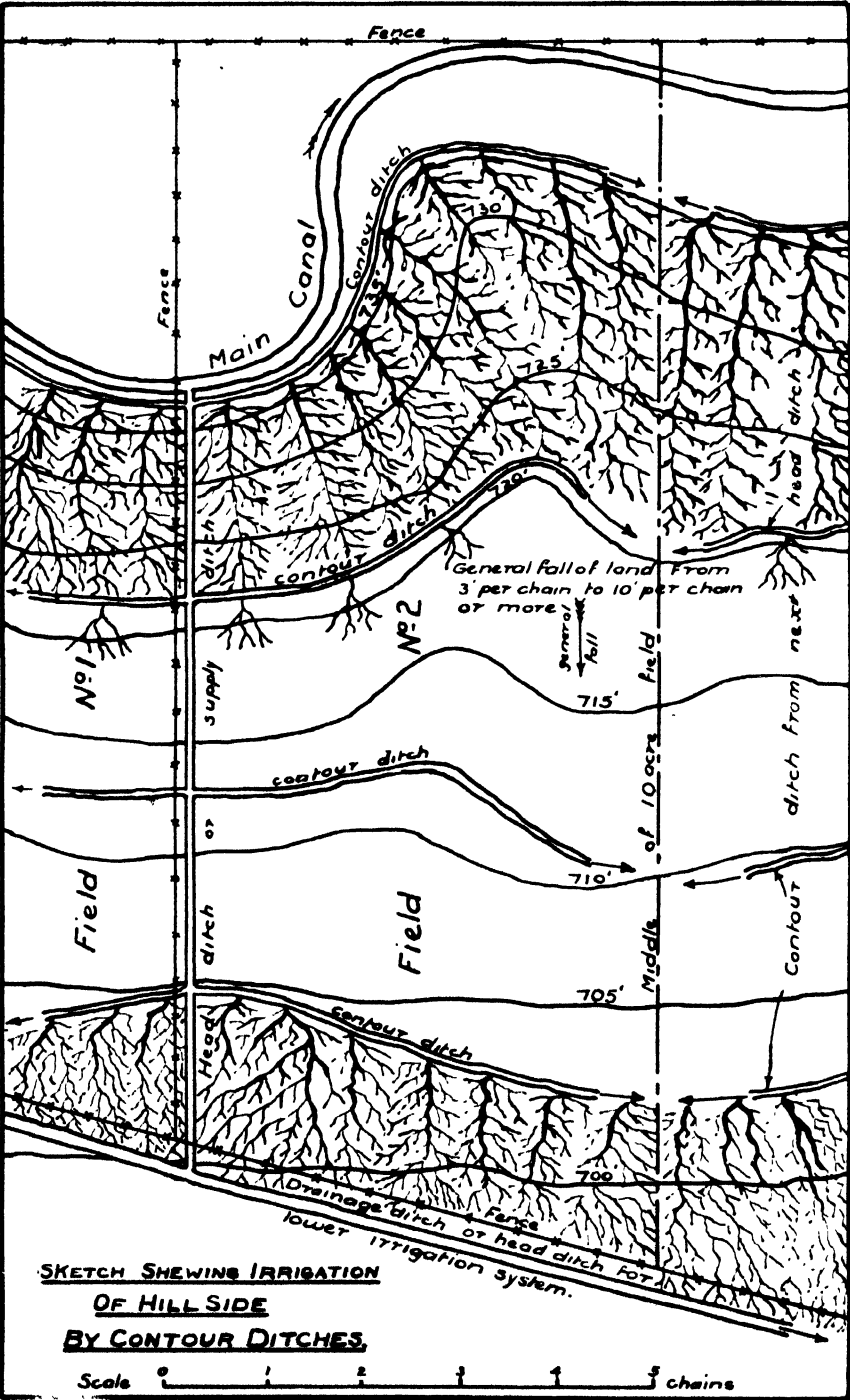


FIG. 22.

[Original.]

allowed to run down unrestricted. This is not recommended, as the gully either erodes or becomes choked with swamp-grasses, which retard the water too much, thus permitting the gully-bottom to absorb too much water, which is likely to come out lower down and cause damage to lower lands by overwetting.

The operation of irrigating is usually worked downward from the top contour ditches, which are shut off as soon as their portions of land are watered. Meantime, any water which escapes from the upper levels will be collected by the lower ditches, and will go towards the fulfilment of their duties. In the initial laying-out of the field the supply-ditches should first be constructed, and the top contour ditch should be made and set in operation. Then the irrigator may decide the exact position of each succeeding contour ditch, as he observes the distance which the water from the one above reasonably irrigates.

The initial cost of this method of irrigation is about £2 10s. per acre for iron for the supply-ditches, plus the small labour of making contour furrows. The latter may be done by the irrigator, but for purposes of comparison it is estimated at 10s. 6d. per acre, making a total initial cost per acre of £3 os. 6d.

As only a small flow of water can be utilized under this method with safety it is rather slow in operating, and may take sixty hours to irrigate a 10-acre field. This may have to be repeated eight times during the irrigation season. After grass is established to hold the soil the irrigator need not be in constant attendance, but will have to leave his other duties several times a day to redirect the flow; or the work, being very light, may be done by a youth.

Flooding from Field Laterals.

As the slope of the land becomes easier, though still of a decided degree, the thin film of water from contour ditches travels too slowly, resulting in over-irrigation near the ditches and complete disappearance of the water before irrigating reasonably wide strips of land. Some method becomes necessary of assisting the flow of water downwards, concentrating it upon a small area for a brief period, and then quickly transferring it to another.

While the slope of the land is still between 3 ft. and 1½ ft. per chain this can be effected by the method of flooding from field laterals (Figs. 23 and 24). The head ditch, instead of being directed straight downhill, is taken somewhat diagonally across the slope, preferably (but not necessarily) at the greatest gradient the soil will stand without protection against scouring. Most soils in Central Otago will stand a grade of 1 ft. 6 in. per chain in fairly small ditches not used constantly and thus protected on the sides by the natural growth of grass. Lateral ditches, on the steepest gradient permissible with safety, are then run off from the head ditch, in an opposite diagonal direction with respect to the general slope of the land. This will make their direction somewhat square to the head ditch. From ½ to 1½ cusecs may be used in this system, the water being concentrated to one or two points in one of the laterals at a time, and let out at these points on to the land by means of canvas dams, which may also be used for diverting it from the head ditch into any lateral (Fig. 25).

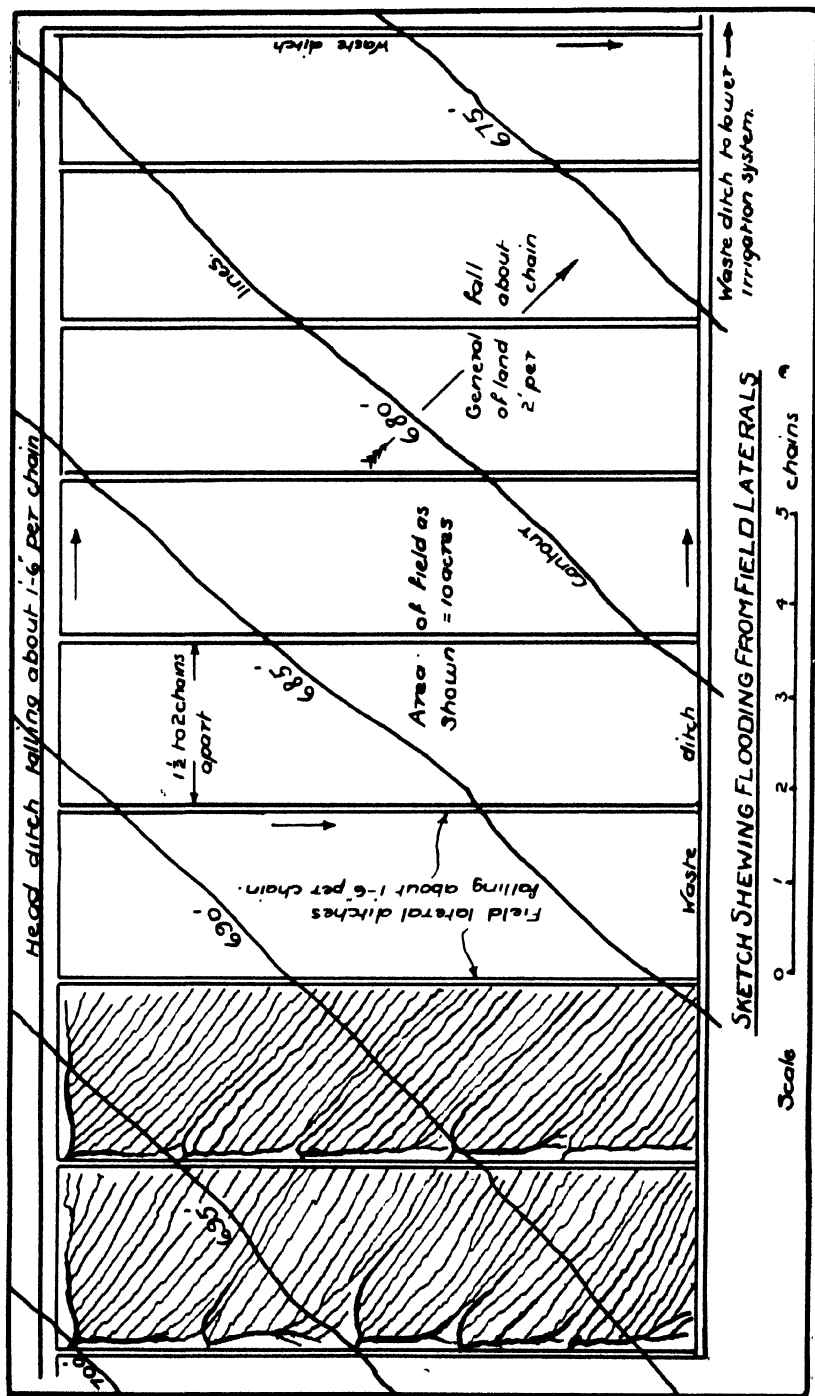


FIG. 23.

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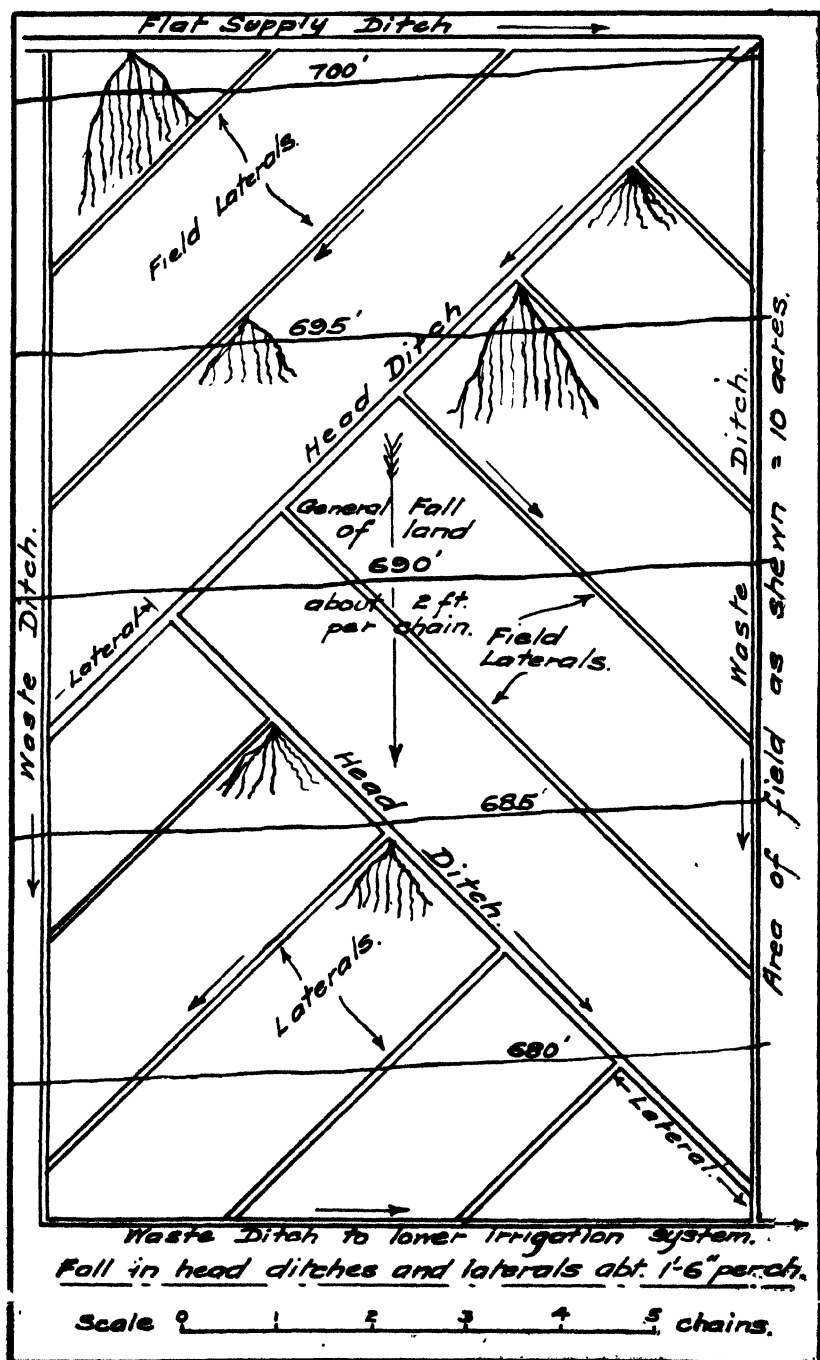


FIG. 24. SKETCH SHOWING FLOODING FROM FIELD LATERALS.

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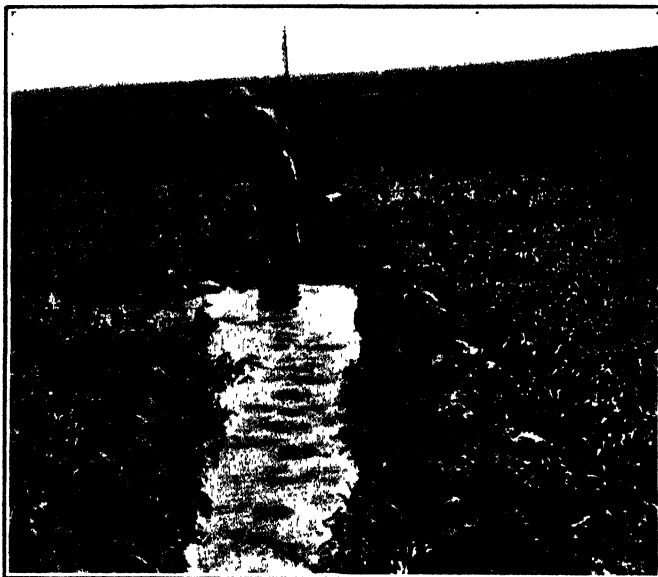


FIG. 25 DIVERTING WATER ON TO LAND FROM FIELD LATERAL, USING CANVAS DAM

[*Canadian Bulletin No. 6.*

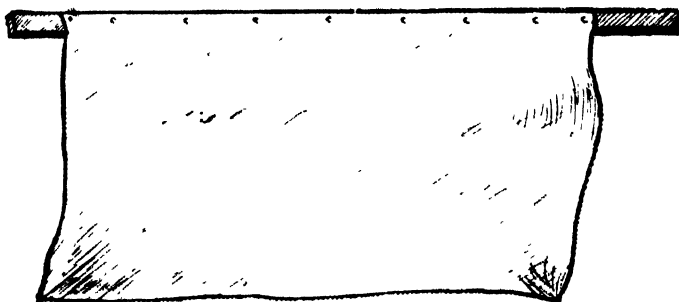


FIG. 26. CANVAS DAM.

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The canvas dam (Fig. 26) is used by resting the rod across the top of the ditch, preferably before the water reaches it, hauling the slack end up-stream, letting it sag into the shape of the ditch, and anchoring it down with sods. It will thus form a fairly watertight dam capable of being moved easily. It is preferable to have a few of these canvases, so that they may be set in advance.

In Fig. 23 the field is assumed to have its main fall running diagonally across it, and in such a case the ditches will run about parallel to the sides of the field. If the fall were directly down the field the system of ditches would be arranged as in Fig. 24.

The whole of the preparation work for this system can be done by the irrigator at a cost estimated at £1 5s. per acre, which is the total cost of preparation. When operating, a man must be in constant attendance. He should, however, be able to irrigate 10 acres in thirty-six hours. The method is a good one, but should be confined to land with about 2 ft. of fall per chain.

Border-ditch Method.

As soon as the slope of the field becomes easy enough to permit water to be run directly down it in ditches without damage the two methods previously described should be abandoned and the border-ditch method used (or one of the methods described later).

Fig. 27 shows the use of this method. The head ditch is taken across the top side of the field on a fairly flat grade, so that if dammed in one place it will back up the water to discharge into two or more of the branch ditches at one time. The head ditch will have to be fairly large, on account of its low gradient, in order to carry a flow of water of, say, 3 or 4 cusecs. The branch ditches are taken off from the head ditch, at intervals of about 70 ft., straight down the fall of the field. They need not be so large, as they will have a considerable gradient. Two furrows thrown in opposite directions and trimmed up a little will form one of these branches. The canvas dam is used for diverting water into the branch ditches (Fig. 28), and also for diverting it out of the latter on to the land (Fig. 29) in a very similar manner to that employed in the field-lateral method. One difference from and decided advantage over the latter is that the border-ditch method waters on both sides of the ditch, and the raised edges of each ditch form borders, confining the flow of the water directly down definite strips of land. Hence the name "border."

The film of water on the land being thus confined very materially reduces the amount of attendance required. One man should be able to irrigate a 10-acre field in fifteen hours.

In the previously described methods, recommended for steeper lands, slight inequalities of the land-surface do not matter much, but in this system it is desirable that the surface be made fairly regular by a little grading, if necessary (though a very high degree of evenness is not absolutely essential). Allowing for a moderate amount of surface-levelling and the construction of the ditches, all of which may be done by the settler himself, the cost of preparation is estimated at £2 12s. 6d. per acre. This method can be used on land with a slope of $1\frac{1}{2}$ ft. per chain or considerably less. It is fairly efficient, and probably the best method to use on lands with slopes between 1 ft. and $1\frac{1}{2}$ ft. per chain. However, on lands having less than 1 ft. of fall per chain there should be no hesitation in discarding it for the border-dyke method.

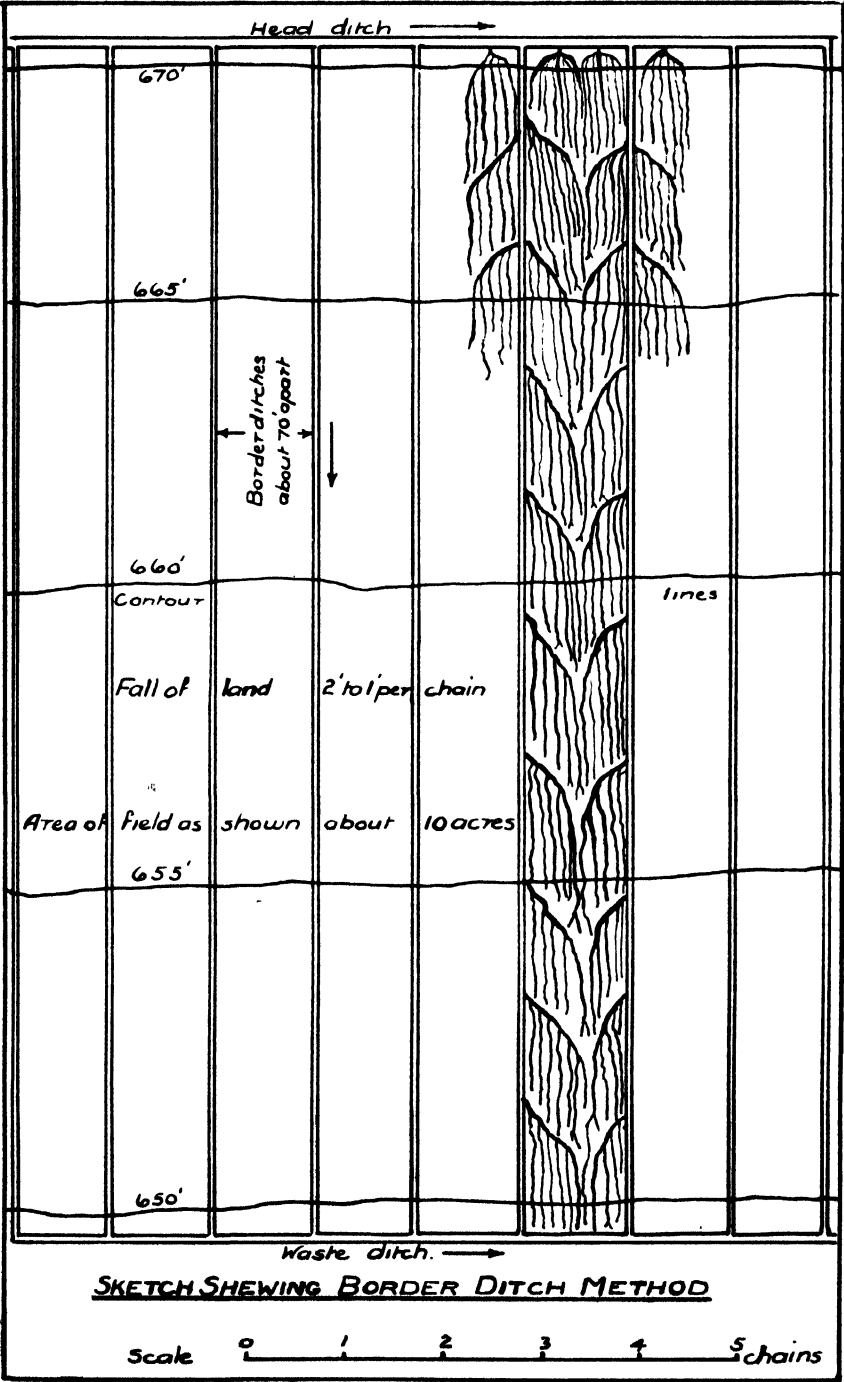


FIG. 27.

[Original.]

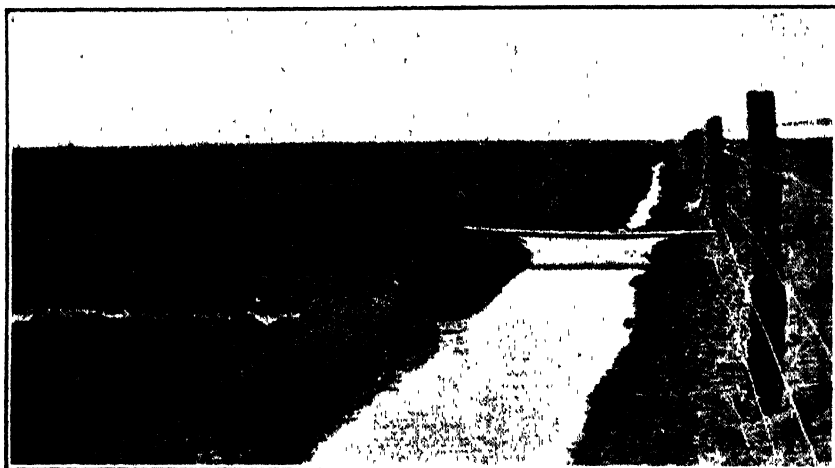


FIG 28 DIVERTING WATER FROM HEAD DITCH INTO BORDER DITCH WITH CANVAS DAM,

[*Canadian Bulletin No. 6.*

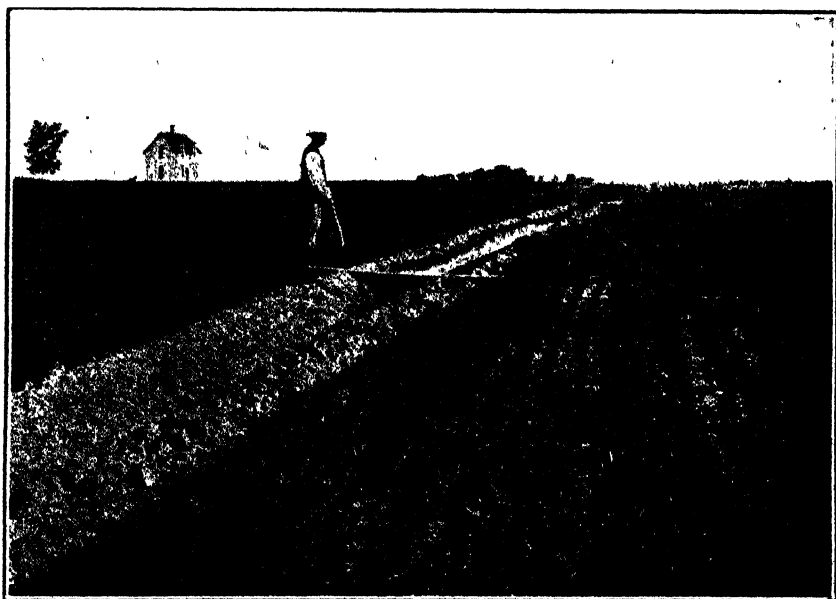


FIG. 29. CANVAS DAM IN POSITION TO IRRIGATE FROM BORDER DITCH.

[*King—"Irrigation."*

Border-dyke Method.

For flat land this method (Fig. 30) is undoubtedly the most efficient, and, though expensive in first cost, is in the long-run the most economical from every point of view.

The head ditches should be formed almost on a dead flat, across the upper end of a field and at further intervals of 10 chains, and, being flat in gradient, must be fairly large, as the method involves the rapid use of a comparatively large flow of water. Instead of leading the water down the field and distributing it in smaller ditches, as with the border-ditch method, it is put on to the land direct from the head ditches. The border ditches are replaced by small levees, ridges, or "borders" running down the direct slope of the land and dividing it into strips. If the land is level across the field, as in the lower half of Fig. 30, the strips will be regular and parallel to the sides of the field. On the other hand, if there is slight irregularity in the contour the strips may be curved to run always at right angles to the contour. In other words, the direction of the borders will follow the steepest direction of fall at each point in their progress from the head ditch. This is to ensure that each strip will be perfectly level in cross-sections at every point. For operating, a large flow is let into the top end of a land. It spreads into an even film a few inches deep confined between the borders, and travels right down the full length of the strip (Fig. 31), watering the land in that strip evenly and thoroughly.

Experiments and experience have shown that the strips should not be more than 10 chains long (the writers are inclined to recommend about 7 chains) and 50 ft. wide. The levees or borders should be about 7 in. high at the start, where the film of water will be deepest, reducing to a couple of inches at the bottom end, where the water should have been reduced in depth to practically nothing by absorption *en route*. These borders are formed by ploughs assisted by a special ridger (Fig. 32). They should be a few feet wide at the base, so that when they have settled and rounded off they resemble gentle waves rather than sharp ridges. If so formed they will present no obstacle to a reaper or other farm implement.

The volume of flow of water used will be decided by the slope of the land, other things (such as the porosity or rate of absorption of the land) being equal. On average porous Central Otago land, for giving a watering equal to about 3 in. of rainfall the film of water should only be on the surface of the land at each point for about thirty minutes. Enough water to irrigate a whole strip must therefore be allowed to run into the head of it in thirty minutes. By this time the travelling end of the film of water will (if the volume of flow has been large enough) have reached roughly four-fifths of the way towards the end. The supply is then cut off at the head ditch and transferred to another strip (or "check," as they are commonly called). The film in the first check will continue to move forward by the accumulated water in the upper end passing on, and if everything has been gauged rightly should just peter out at the bottom end.

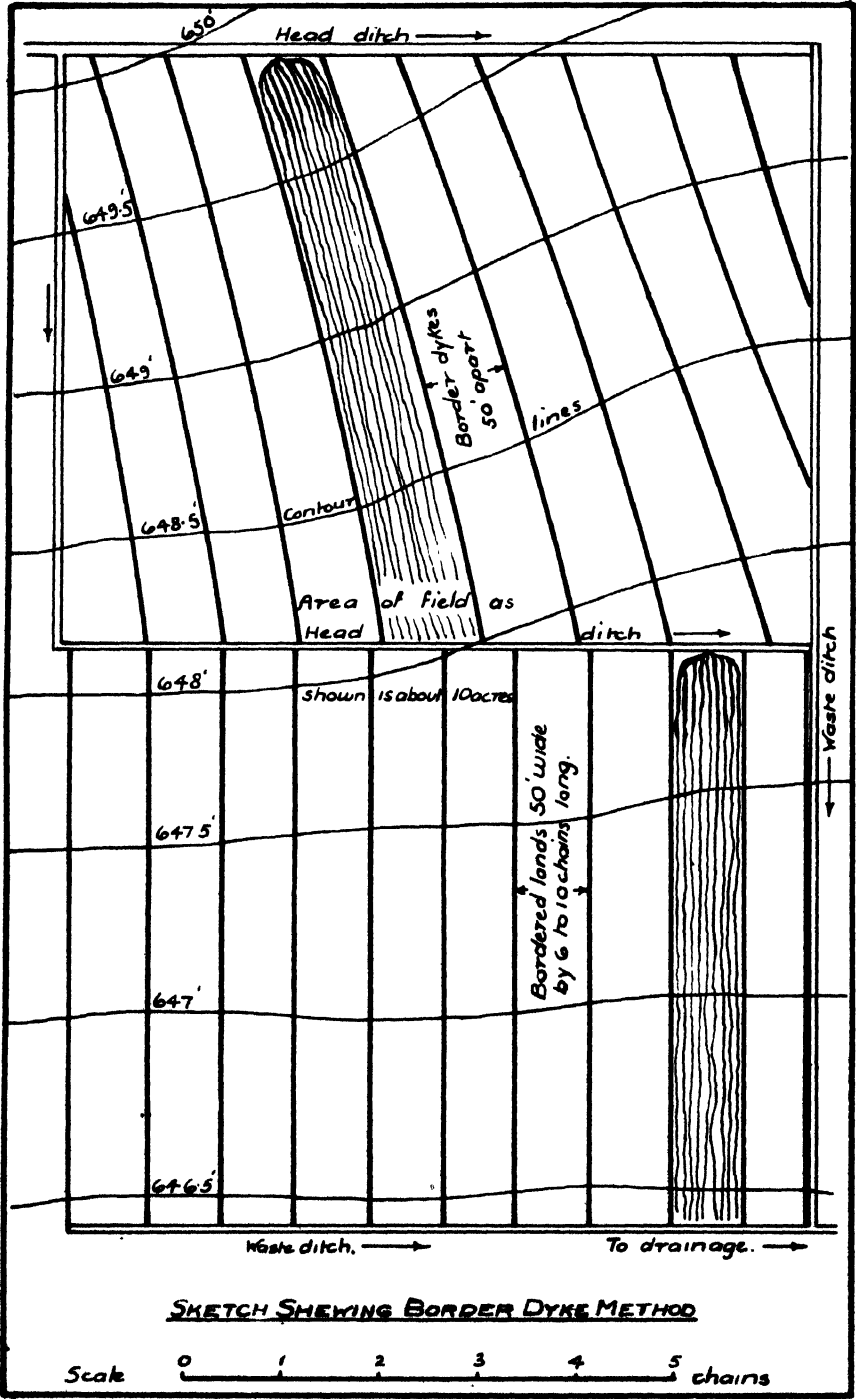


FIG. 30.

(Original.)

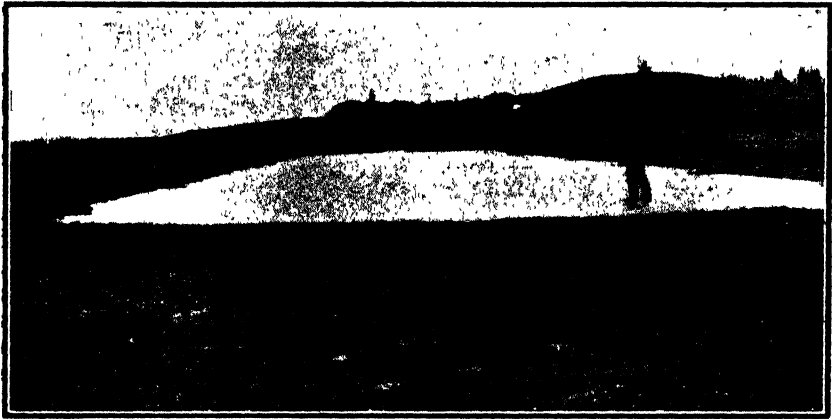


FIG 31. FILM OF WATER FLOWING DOWN BETWEEN BORDERS IN BORDER-DYKE METHOD, AT GALLOWAY EXPERIMENTAL AREA.

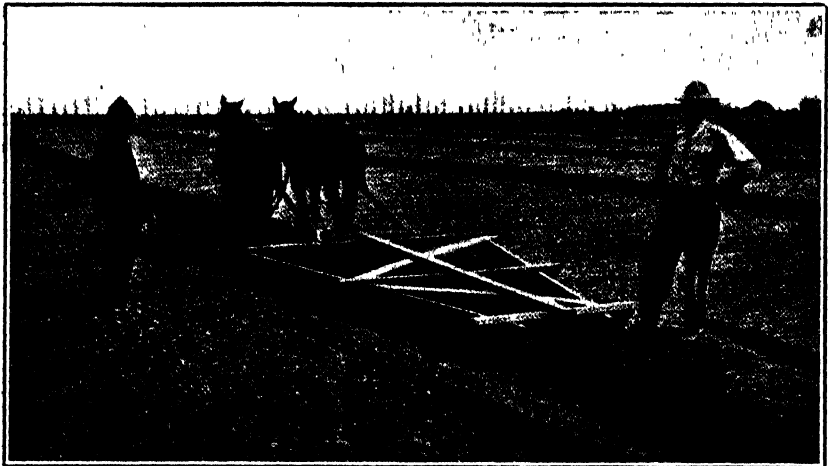


FIG. 32 USE OF RIDGER FOR FORMING BORDERS

[Canadian Bulletin No. 6.]

It might appear at first sight that this method would over-irrigate the top end and leave the lower end underwatered. However, this is not so. The amount of water which soaks in at any point is not dependent upon the depth which may be passing over the surface at that point, but rather upon the length of time during which free water of any depth has been resting on the surface. Almost immediately the supply is cut off, the film at the upper end, being a few inches deep and thus having more velocity, runs forward, leaving the surface there uncovered. But its progress at points lower down is slower and slower. It therefore takes longer to run off these lower points, and this happens to compensate in a remarkably correct

manner for its not having reached these lower points so soon when the supply was coming on.

The volume of water used should be adjusted by trial to give the proper effect. Roughly, for land with a gradient of 1 ft. per chain a flow of about 3 cusecs should be used, increasing to 6 cusecs when the gradient reduces to 3 in. per chain. Not often will land be found to have a lesser fall than 3 in. per chain, but this method can be used for very much flatter land by increasing the size of flow. As the whole essence of this system is speed and precision, canvas or sod dams are not recommended; but a simple wooden gate should be set in the side of the head ditch leading to each check. Also, one of these gates will be necessary in the branch ditch leading from one head ditch to the next, so as to hold back the water in the upper head ditch while it is in use. These gates should be about 6 ft. wide but only one board deep: that is to say, the movable part consists of one board, with handle to lift it by, set in a simple frame (Fig. 33).

It will readily be seen that the land must be smoothed perfectly and made quite level in cross-section, or the film of water would run all to the low side. The main levelling, such as cutting off decided hummocks and filling into hollows, is done in the first place with horse scoops or scrapers, and the finer levelling by special implements (which can be home-made). Even the slight hollows made by the removal of the soil for the borders must be refilled by scraping a little soil into them from the middle portion of the lands, and the ordinary road-grading machine comes in very useful for this work. The matter of irrigation implements will, however, be dealt with more fully in a later article.

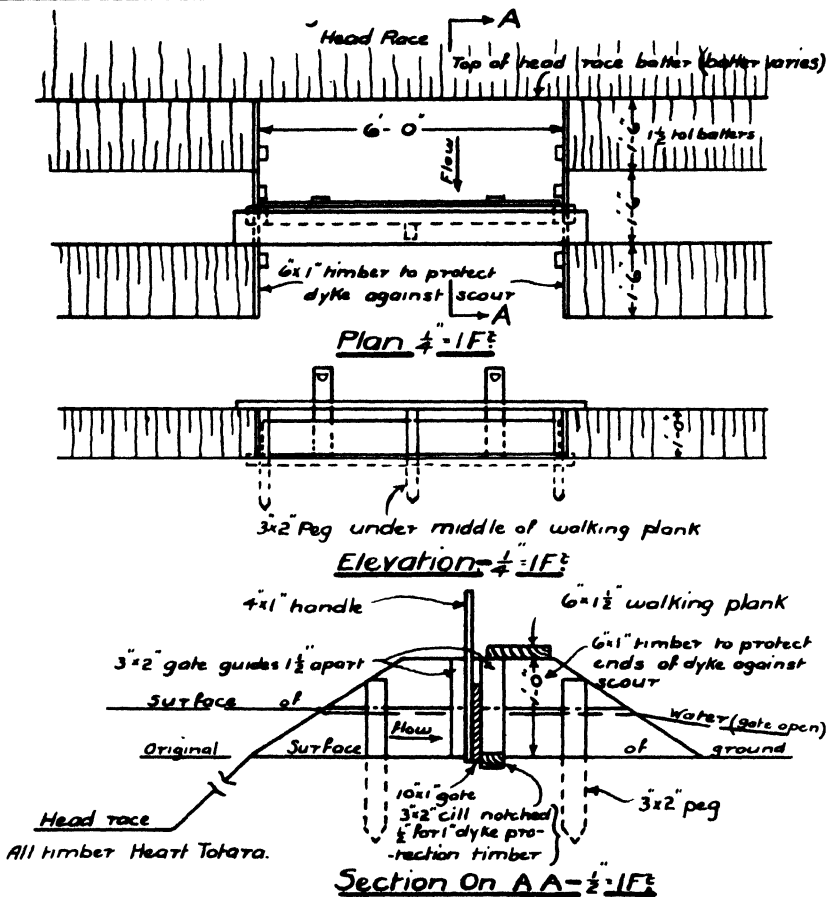
The initial cost of preparation for the border-dyke method is much higher than for any of the others yet described, being as follows per acre:—

Labour making head ditches	..	..	..	£	2	0	d.
Making borders	..	..	..	..	0	18	0
Levelling field (varies)	..	..	..	..	1	0	0
Making head-gates	..	..	..	..	0	7	6
Total labour (including horse-hire) ..				..	4	5	6
Materials for head-gates	..	..	..	..	0	14	6
Total initial cost per acre				..	£5	0	0

It will be seen that only a very small portion is for material, and that all the rest can be done by the farmer and his teams.

Though the initial cost is much higher than for other methods, it should be remembered that it is non-recurring, and it is amply justified by economy in labour for all time thereafter, in the amount of water used (which has to be paid for), and, still more important, in evenness of irrigation, ensuring the best crops. The work when done is an added and visible improvement to the capital value of the land.

By this method one man can irrigate 10 acres in eight hours, and, what is more, knows that every inch of it has been done thoroughly. It is the only really scientific method known, and settlers should be prepared to undertake very considerable grading and levelling work to adapt even very uneven land to its use.



Material List For One Gate.		
Section	Numbers & Lengths	Where Used.
3x2	3/1-9" 1/6-9" 4/1-0"	Pegs, Sill & Gate Guides
10x1	1/6'	Gate
4x1	2/1-9"	Gate handles
6x1	1/12'	Against ends of Dyke.
6x1 1/2	1/7'	Walking plank
nails		

SKETCH SHOWING TYPICAL OUTLET GATE FROM HEAD RACE INTO CHECK

FIG. 33.

[Original.]

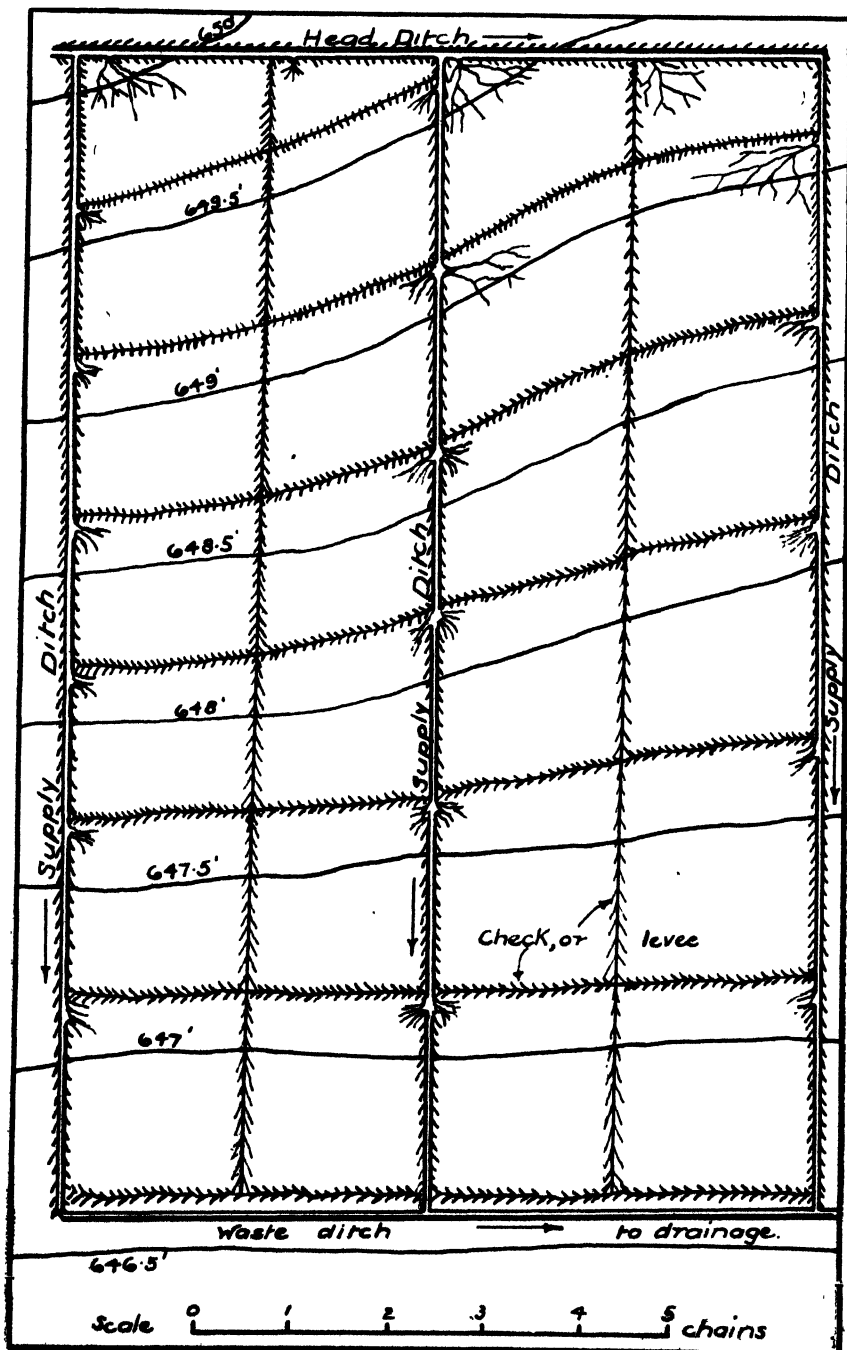


FIG. 34. SKETCH SHOWING SAME FIELD AS IN FIG. 30 UNDER BASIN-CHECK METHOD.

[Original.]

Basin-check Method.

This is a method (Fig. 34) which, though very old and adapted for very flat land, has been largely replaced for field irrigation by the more speedy and labour-saving border-dyke method. It consists essentially in forming basins or ponds on the land by throwing up slight mounds or checks and flooding each consecutively. For market-gardening and orchard irrigation (Fig. 35) it is still recommended in the right circumstances. Where the land is practically dead-flat and even, the basins will be rectangular and regular, but if on a slight slope they will conform in shape to the contours of the land.



FIG. 35. BASIN-CHECK METHOD USED IN ORCHARD.

[Mosier and Gustafson—"Soil Physics and Management,"

The size of each pond will depend upon the flow of water available. The method would not be practicable to use on fields with a slope greater than about 6 in. in 2 chains (unless the irrigator were prepared to terrace the land). In Fig. 34 the field has about the maximum slope as mentioned. The hatched markings represent slight levees which could be formed with a plough. Those running across the field would be 6 in. high throughout, to pond up the water that height and make it back up to the upper edge of each enclosure. The ridges running up and down the field would have practically no height at the upper edge of each pond and increase to 6 in. at the lower edge.

For a lay-out as shown in Fig. 34 a flow of about 5 cusecs would have to be applied to each basin for about fifteen minutes. It would then be turned into the next lower basin, and the embankment between the two immediately cut to allow the surplus water impounded in the upper basin to also run into the next. It would cost fully £6 per acre to prepare properly with gates, and, though just about as speedy as the border-dyke method, would take two men to operate over the same area. This means that it would be about twice as costly to manipulate. It is recommended only for odd corners of a field not large enough to set out in borders.

Wild Flooding.

This method cannot be recommended under any Government irrigation scheme. In very exceptional circumstances, where plenty of water is available without extra cost and good drainage exists, it might be employed.

Summary of Costs and Expenses of Surface-irrigation Methods.

The following is a summary of the per-acre costs and operating-expenses of each system described, assuming eight irrigations in a season :—

Table 9.

Method.	Initial Cost.									Annual Cost of Operating.		
	Labour.			Material.			Total.					
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Flooding from contour ditches (man two-thirds time)	0	10	6	2	10	0	3	0	6	2	10	0
Flooding from field laterals ..	1	5	0	..	..	..	1	5	0	2	8	0
Border ditch	2	12	6	..	..	..	2	12	6	1	0	c
Border dyke	4	5	6	0	14	6	5	0	0	0	10	8
Basin check	3	16	6	2	3	6	6	0	0	1	1	4
Wild flooding .. ..	..	..	..	..	..	..	..	..	..	..	..	..

NOTES.—Labour is allowed for at 13s. 4d. per eight-hour day. Horse-hire is included with labour at 7s. per eight-hour day for each horse. Ordinary cultivation has not been included in cost of preparation of the land. The cost of the wild-flooding method is extremely small, but not possible to estimate.

The Influence on Agriculture on International Relations was a subject considered by the Paris International Congress of Agriculture last year. It was held that an association of the leading agricultural and pastoral societies of the world would lead to the development of sound international good-fellowship, and the elaboration of a common programme for the benefit of world agriculture.

Noxious Weeds.—The Tomahawk Road Board has declared Californian thistle not to be a noxious weed within its district. The Foxton Borough Council has declared the whole of the plants enumerated in the Third Schedule of the Act to be noxious weeds within that borough. Matakaoa County has declared Bathurst burr, foxglove, gorse, milk thistle, and Japanese wineberry to be noxious weeds.

THE BUSH-SICKNESS INVESTIGATION.

LABORATORY WORK AND RESULTS.

(Continued.)

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

SOME DISCARDED HYPOTHESES—continued.

IN the early stages of this investigation the livers of the affected animals were specially examined for inorganic (mineral) poisons, which are usually retained in greater amounts by the liver than by any other organs or tissues. Copper was found to be present in greater amounts than was suspected to be normal, judged by European experience, which raised the presumption that copper might be acting as a slow cumulative poison. This possibility was thoroughly investigated. Many specimens of livers and other organs from bush-sick and healthy animals were obtained from both cattle and sheep, and the copper was accurately determined by gravimetric and colorimetric analysis. Feeding experiments were carried out with sheep, calves, and rabbits over a period of seventeen months, and, although the livers of the animals fed with copper-salts were found to contain abnormal amounts of copper, larger than anything met with in the examination of the bush-sick animals, no evidence could be obtained to show that the copper ingested had exercised any injurious effects. The results were published fully in *Transactions of the New Zealand Institute*, Vol. 44, 1911, p. 288. Investigation showed that the high copper content of the livers of bush-sick animals was an abnormality shared with healthy sheep killed for consumption in parts of New Zealand other than the bush-sick area. Analyses of grass-ash and soils did not show any exceptional amounts of copper.

Poisonous elements generally have been sought for, and spectroscopic examinations made of the ash from animals and plants, and of soils from the affected area, with a view to detecting unusual quantities of the rarer elements which might have a poisonous effect on the animal. Entirely negative results were obtained in these analyses.

POSSIBLE AND PROBABLE HYPOTHESES.

There is therefore, in the poison hypothesis, only the possibility of a poisonous organic compound developing in or on the pasture to consider. This is such an unlikely suggestion that it has not once been made by any of the distinguished authorities whom the writer has consulted upon the matter, nor by local veterinarians, many of them particularly able men—such as the late J. G. Clayton—who have from time to time engaged in the field-work. In fact, the slow-poison hypothesis has been suggested only with the view that some mineral or inorganic poison, such as arsenic, might be present. The idea that some cumulative vegetable (organic) poison, alkaloid, glucoside, or other toxin might develop in or on the grasses and clovers grown on pumice lands has been advanced only in a general way by farmers, who assert that the clover is bitter to the taste, and that stock manifest

an indifference to it—a fact which may be explained on other grounds (see later paragraph dealing with balance of food constituents). It seems extremely unlikely that the same organic poison should be produced in such differently related plants as clovers and grasses, and yet animals seem to develop bush sickness impartially, either when the pasture is almost wholly clover or when it is mostly grass.* Again, if a slow cumulative poison is at work the addition of a comparatively small amount of food grown outside the affected area, such as bran, molasses, &c., or turnips and hay grown on the premises, should not, one would think, render the animal immune to the poison, or, what is still more improbable, effect a cure when the animal is once sick—bearing in mind that the animal is still feeding on the food, although in diminished amounts, which is suspected of contributing the poison.

The underlying idea in most minds which have considered the problem has been expressed in the form of a deficiency hypothesis, or, in other words, a starvation due to “something wanting in the soil,” as the man on the land phrases it. The writer has, however, an open mind on the possibility of an organic poison being a contributing cause of bush sickness, considering the clovers belong to the Leguminosae, a family which contains certain plants known to produce chronic poisoning in men and animals under the names lathyrism and locoism, the active principles causing which have so far evaded all attempt to isolate them.

The other matter to consider is whether the organic nutrients are properly balanced in the food-supply, and in this respect there is decidedly room for research. The writer has seen farms on which there was little else to be perceived but clover, and in this case one would think that beasts pastured thereon were getting too much protein, there being possibly not enough grass available to sufficiently dilute the natural pasture. In one case the writer noticed that wherever the cattle could get a patch of grass they had grazed it closely down, leaving a bare patch surrounded by tall clover. The cattle on one farm in the clean area were certainly not looking as well as they should, and there was here everywhere a rank growth of clovers and little grass to be seen. It is therefore quite conceivable that excess of proteids in certain pastures may result in an inferior condition in the stock through the difficulty of eliminating the excess of proteid phosphorus and sulphur, leading to the condition known as acidosis. Whether the sulphur when eliminated as sulphuretted hydrogen from the food ingested has any inhibitory effect on the assimilation of iron from the food is a subject for future research. It may, however, be observed that cattle beasts fed on pasture top-dressed with iron-salts, and which was proved by analysis to contain much more iron than the normal pasture on bush-sick land, passed dung which was much blacker in colour than usual, presumably due to the formation of sulphide of iron—a black compound.

On the ordinary bush-sick farm, where the pasture is that resulting from a surface sowing after a burn, the animal should be able to choose the quantities of each class of the ration, whether of the proteid-

* Experiments will, it is hoped, be set on foot to determine this point definitely.

yielding clovers or of the carbohydrate-yielding grasses, to enable a balanced ration to be consumed. The good results obtained in feeding molasses may have been brought about by effecting a better balance in the albumenoid ratio in the food, molasses being wholly carbohydrates. For the information of those not acquainted with New Zealand practice who desire to compare bush sickness with nutrition diseases in their own countries it may be pointed out that the growth of grass on the Patetere Plateau, where the Mamaku farm is situated (about 1,800 ft. above sea-level), is sufficient to provide the chief ration in winter. Milking-cows may be rugged, but store beasts are not, neither are they housed nor artificially fed. The only extra attention which they obtain during the three months of winter is that they may be given a little turnips and hay on those farms where any land has been brought under the plough. The growth of pasture is sufficient to keep stock in good store condition during the winter, especially if they have a little bush (forest) to go into for shelter during frosty nights or in cold sleety weather. This is assuming that they are not overdue for a change to healthy country—the farmer's method of combating the bush sickness, an expedient simple in itself but involving the use of change-paddocks or the possession of a second farm—a capital-absorbing proposition.

At this stage it may therefore be concluded the most feasible hypothesis is that there is some necessary constituent of the food-supply which is either not present in sufficient quantity in assimilable condition, or that some pathological condition of the animal induced by an abnormal or unbalanced food-ration (of organic or inorganic nutrients) is responsible for the condition known as "bush sickness" in ruminants.

It will be now necessary to discuss in considerable detail the actual conditions which prevail in the bush-sick country, in order that something may be evolved from the evidence which may be dignified by the name of "theory."

II. THE ROCKS AND SOILS.

According to Professor A. P. W. Thomas ("Report of the Eruption of Tarawera," Wellington, 1888, p. 19), the soils which will be taken as typical of the bush-sick country in this article, and on which the Mamaku farm stands, had their origin in what he calls the "Rotorua shower of ash." Other huge ash-showers have considerably modified the surface of the country in the thermal regions, and have also extended their influence to the east as far as the coast in Hawke's Bay and the Bay of Plenty. The Waikato River has carried pumice to the north and deposited it over a very wide area of country, influencing the subsoil as far north as Auckland City and weathering into clays, according to Jameson (*New Zealand Journal of Science and Technology*, Vol. ii, May, 1919). The Kaimanawa and the Ruahine Ranges have been well peppered with ash in the south, while in the west and south-west the volcanic rocks have left traces wherever water will flow and pumice will float.

For the present, in order that the results shall be as comparable as possible, it is intended to confine attention to the soils resulting

from the Rotorua ash-shower, except where others are inserted for the sake of comparison. This shower had its origin, Thomas considers, in a spot near Tikitapu and Rotokakahi, as the ash thickens in that direction, and has been spread out over a vast expanse of country. Thomas's description of the extent and nature of this soil-forming rock may be quoted in full; it is not capable of condensation, and the localities mentioned will aid in the comprehension of the incidence of bush sickness. He writes:—

All around the basin in which Lake Rotorua lies the present surface is formed by a pumice-ash some feet thick, in layers which follow the contour of the ground, the coarsest fragments being below, the finer at the top passing into brown pumiceous soil. The greatest thickness of the ashes, so far as I observed, was along the Wairoa Road, about three miles east of the Rotorua Township. There the ashes varied from 7 ft. to 10 ft. (in one place 15 ft.) in thickness. The surface layer, of course, consisted of soil, a brownish pumiceous loam stained with vegetable matter; this passed down into a brownish sandy substance, which doubtless represents the finer pumice ash, for small pumice-fragments were to be detected in it. This gradually becomes coarser and less decomposed in character till at 4 ft. from the surface it passes into unmistakable but fine pumice-ash. Below, the pumice-fragments grow larger, and are arranged in distinct strata with a peculiar wavy character about the layers, which reproduces the details of the stratification shown by the ashes of the late eruption of Tarawera. The coarsest fragments are at the bottom, and reach the diameter of 1 in. or 2 in., or exceptionally as much as 4 in. Below the pumice is a brown loamy layer, which doubtless represents the land-surface which was overwhelmed by the ashes above. About 85 to 90 per cent. of the fragments consist of a pumice weathered buff or cream-coloured outside, but white and fresh within. The remainder consists of fragments of obsidian, pitchstone, and various rhyolites. All the largest fragments are pumice.

The layers of this pumice-ash follow the present contour of the land, and this character, as well as the freshness of much of the pumice, seems to indicate that the shower took place at no very distant date—probably not long before the Maoris came to New Zealand. On the west side of Lake Rotorua are to be seen old lake-beds deposited when the water stood at a higher level, before the drainage-channel to the north was lowered. The lake had been lowered and the lake-beds subject to denudation before the pumice-shower fell, as may be clearly seen in the sections afforded by the road-cuttings.

I have traced the present deposit in various directions, and its characters conform everywhere to the principles formulated above. It will not be necessary to enter into details, but simply to state that to the west it may be traced for twenty-four miles along the Rotorua-Oxford (Tirau) Road. The soil in the forest along this road (Cambridge Bush) is brown; below it passes into a yellowish, more or less fine pumice-ash. The last distinct trace of this is seen at a point ten miles east of Oxford; but the character of the soil would seem to indicate that the shower extended farther to the west, though now all the fine ash is decomposed. To the north it may be traced along the Tauranga Road past Awahou as far as Oropi, thirty-two miles from Ohinemutu. Along the Maketu Road it may be followed as far as Waiwhakaretu (twenty-nine miles). To the south the ash may be seen at Pakaraka (eleven miles from Rotorua), where it is still several feet thick, and at Pareheru. It may also be traced still farther along the Wairoa Road to Tikitapu and Rotokakahi; but the thickness of the more recent ash renders continuous observation difficult here, and I have had no opportunity of detailed study.

It will be seen from this extract that the land-surface is here provided with a new covering of rock of such a physical nature that it speedily becomes a soil, unlike other rocks which require perhaps thousands of years to decompose and weather down into a state sufficient to support field crops. A very unusual feature is the attempt to predict the age of the deposit not in geographical time, but in terms

much less definite and remote.* Mr. Elsdon Best informs the present writer that Maori tradition—on which there is no greater authority than Mr. Best himself—places the arrival of the Maori in New Zealand at about forty generations back, which would mean something like one thousand years. The forest on the portion of the Patetere Plateau, near Mamaku, with which we are chiefly concerned, was probably all killed out by this great shower, and possibly the young forest which arose was something quite different and of a greater economic value than the forest it replaced, since pumice quickly becomes an excellent soil for tree-growth. The adjacent areas of rhyolite which have escaped the pumice-shower are now growing a very much older forest, the old trees of which consist of *Nothofagus fusca* (red "birch"), *N. Menziesii* (Southland "birch"), and *Metrosideros robusta* (northern rata) of a very much greater age than anything on the pumice soils. The whole physiognomy of the Mamaku pumice forest gives one the impression of a young forest. Any one going to Rotorua can see for himself the truth of this, as the scenic reserve extending some miles along the railway frontage has been preserved from the sawmiller. The oldest of the trees are under one thousand years of age.

The Rotorua County may, as stated, be said to have been provided with a new soil several feet thick by the Rotorua pumice-shower. There are, however, a few exceptions to this statement. First and chiefly, the 1886 eruption of Mount Tarawera provided from that date a portion of the eastern side of the lake with a new and fundamentally different soil, known locally, from the fact of its having fallen in a plastic condition, as the "mud." This is the soil upon which rests the well-known Te Ngae Mission Farm. The farm has been worked for the past seventy years or more, and has a reputation for fertility and freedom from disease unequalled in the district. This mud-shower deposit thins out towards the Wairoa Road to the south of Te Ngae, but still influences the land there to its great advantage. There is no difficulty in rearing lambs to maturity on this mud country. Secondly, the rhyolitic breccia pillars or volcanic necks, so prominent a feature of the Mamaku landscape, by their erosion and decay provide a certain amount of top-dressing to the pumice in the immediate vicinity of such rocky outcrops. In some parts where this rhyolitic rock comes to the surface, so that the soil is formed from it in large areas, it forms a soil differing from that derived from air-borne pumice, and supports a different vegetation. This soil grows pasture which possibly does not induce bush sickness. The mechanical condition of the soil is different, containing more silt, fine silt, and clay than the pumice soil.

Mechanical condition of the soil is probably the primary cause of bush sickness. Coarse sandy soils suffer from many defects which tend to counterbalance any advantage in ease of working. Further, there is reason to believe that bush sickness is not confined to pumice lands or even volcanic lands in New Zealand, although, owing to the wide extent of these, the disease is able to run its course. It is suspected that bush sickness exists in a milder form on coastal sandy lands

* The pumice was formed in the volcano at a far earlier epoch than this, and may have undergone considerable weathering before its redistribution by a series of explosions, at which time, however, it was still a rock, not a soil.

or sand-dunes which have been grassed. The only obvious point of resemblance between sand-dunes and pumice lands is the coarseness of the soil-particles and the want of cohesion between them. The difficulty of diagnosing such malnutrition troubles in stock is great. Dune sandy lands exist in strips along the coast-line and abound in hollows or depressions often of considerable extent, and these contain soil of great fertility, having before drainage and improvement carried flax swamp or even white-pine forest. Naturally, the first thing a farmer would do on finding that his sheep were "not doing too well" on the hills—running at the eyes and becoming emaciated—would be to change them to an area growing better feed, where they would recover, and the trouble never becomes acute enough to obtain thorough investigation and recognition.



RHYOLITIC PILLARS OR NECKS, MAMAKU DISTRICT.

[Photo by B. C. Aston.]

Cases which have been suspected to be akin to bush sickness, in that they could not be referred to any other malnutrition disorder or other disease, have come under notice from time to time in such widely separated sandy lands as those of Waikanae, Cape Farewell, and West Wanganui Inlet. The "coast disease" in King Island, Tasmania, may be something similar. Again, in Nairobi, British East Africa, on a volcanic-ash soil exists a wasting, non-transmissible disease in cattle, with no *post-mortem* lesions or pathogenic organisms, but evidence of extreme anaemia, which disappears when the animal is removed to a different type of soil or a *red* volcanic soil, and a complete recovery is made. The condition of the soil upon which bush sickness develops is always one of excessive aeration, judged by the excessive amount of pore-space. It appears that soils which give rise to malnutrition diseases in plants and animals—chlorosis and anaemia—are often soils of loose texture and coarse nature, and frequently are alkaline due to excess of carbonate of lime in the soil.¹ It is significant that application of lime hydrate or carbonate as a top-dressing to pumice pasture-lands causes ruminants pastured thereon to become bush sick in a shorter time than they would on land not so treated. Although the grass of bush-sick country is not obviously chlorotic, observers have professed to detect a lighter shade of green in grass on pumice soil than that found on normal soils.

TABLE 1.—CHEMICAL ANALYSES.

(Results, except *, are percentages on soil dried at 100° C.)

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification. ("Available" Plant-food.)					Hydrochloric-acid Extract. ("Total" Plant-food.)					Citric- acid Extract.
		* On Air- drying.	* At 100° C.	On Ignition.		Lime. CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	Iron, Fe.	Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	Iron, Fe.		Manganese, Mn.
PUMICE SOILS OF TYPICAL BUSH-SICK COUNTRY.																
M 226	Te Pu (unmanured grassland)	..	1.86	7.78	..	..	0.035	..	Trace	0.030	0.100	..	..	0.060	..	0.023
C 825/5	"	..	29.72	7.79	..	..	..	..	Trace	0.044	..	..	..	0.060	0.710	0.039
C 468/4	"	..	10.40	7.30	..	..	..	..	Trace	0.023	..	..	..	..	0.530	0.022
C 825/4	"	..	26.60	8.07	..	..	..	..	Trace	0.034	..	..	..	0.040	0.830	..
D 36/4	" (flooded)	..	27.69	7.55	0.260	0.156	..	0.010	0.017	0.046	..	..	..	0.060	..	0.021
M 223	Rotorua-Tauranga Road (cultivated)	..	1.22	5.63	..	..	..	..	..	0.030	..	..	..	..	..	0.023
M 224	" (uncultivated)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
L 94	Mamaku (unmanured)	..	25.32	15.48	0.371	0.130	0.026	0.019	0.007	0.042	0.220	0.080	0.090	0.030	..	..
M 237	"	..	14.24	10.42	..	0.140	0.017	..	..	0.064	..	..	..	..	..	..
C 825/3	" (recent burn)	..	48.67	20.71	..	..	..	..	Trace	0.067	0.413	..	..	0.070	0.970	0.017
D 348/1	"	..	36.14	12.25	0.254	0.131	0.018	..	0.006	0.064	0.367	..	..	0.058	0.910	..
D 348/2	" (manured with iron)	..	38.46	17.68	..	0.122	..	0.017	0.005	0.064	0.367	..	..	0.074	1.130	..
M 251	Lichfield (cultivated)	..	5.14	11.87	..	..	..	..	..	0.022	..	..	..	..	..	0.017
M 252	"	..	3.48	11.71	..	..	..	..	..	0.043	..	..	..	..	..	0.015
M 253	" (virgin soil)	..	2.60	10.70	..	0.050	0.031	..	..	0.057	..	..	..	..	..	0.021
C 468/1	"	..	12.00	13.30	..	..	..	..	..	0.030	..	..	..	..	..	0.099
D 348/7	" (control paddock)	..	34.68	12.68	..	0.074	..	..	0.008	0.023	0.389	..	..	0.130	0.830	..
C 137/3	Lichfield (unmanured, but cultivated in past)	..	41.51	11.79	..	0.133	..	0.010	0.029	0.070	..	..	..	0.109	0.980	..
TYPICAL PUMICE SOILS OF COUNTRY NOT BUSH SICK.																
M 231	Ngongotaha (pasture in stumps, un- cultivated)	..	5.04	23.31	..	0.035	0.017	0.027	..	0.315	..	..	..	..	..	0.027
C 825/7	Ngongotaha (river terrace—pasture)	..	36.23	..	..	..	..	..	0.028	0.078	..	..	..	0.110	1.190	..
C 1004/4	Ngongotaha (lake terrace—pasture manured with phosphate)	..	39.16	..	..	0.244	..	0.023	0.057	0.101	..	..	..	0.250	0.950	..
D 348/5	Ngongotaha (swampy land near lake- level—rough pasture)	..	35.84	10.34	..	0.158	..	0.013	0.011	0.102	0.445	..	..	0.120	0.810	..
D 348/6	Ngongotaha (another locality, similar to 348/5—rough pasture)	..	35.20	6.68	..	0.045	..	0.009	0.007	0.129	0.204	..	..	0.100	0.850	..

TABLE 1.—CHEMICAL ANALYSES—*continued*.
(Results, except *, are percentages on soil dried at 100° C.)

Laboratory No.	Locality.	Volatile Matter.			Total Nitrogen.	1-per-cent. Citric-acid Extract. Dyer's Method. Hall's Modification. (" Available " Plant-food.)					Hydrochloric-acid Extract. (" Total " Plant-food.)					Citric- acid Extract.	
		* On Air- drying.	* At 100° C.	On Ignition.		Lime. CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	Iron, Fe.	Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	Iron, Fe.		
NON-PUMICE SOILS, ROTORUA DISTRICT—NOT BUSH SICK.																	
C 1317/4A	Te Ngae (1886 eruption mud—pasture)	24.74	4.67	..	..	0.186	..	0.016	0.044	0.135	..	..	..	..	0.096	1.540	..
D 36/5	Wairoa Road (tutu and fern)	21.25	5.36	..	..	0.102	..	0.017	0.047	0.240	..	..	..	..	0.094	1.420	..
D 36/6	Wairoa Road (tutu and fern)	26.65	5.44	..	..	0.146	..	0.024	0.031	0.184	..	..	..	..	0.086	1.510	..
D 1121/13	Te Ngae (white-pine swamp)	23.89	3.51	0.066	..	..	..	0.030	0.025	0.178	2.050	0.760	0.110	0.030	0.803	0.803	..
D 1121/14	" (hillside fern land)	17.76	3.99	0.096	..	..	..	0.023	0.022	0.101	1.740	0.860	0.270	0.050	1.508	1.508	..
C 1317/5	Reporoa (drained swamp)	71.36	48.81	..	..	0.252	..	0.070	0.031	0.301	..	..	..	..	0.331	0.938	..
C 1317/9	"	46.34	21.04	..	..	0.243	..	0.043	0.120	0.222	..	..	..	..	0.150	18.150	..
C 348/9	Onuku, near Lake Rerewhakaite	5.30	..	..	..	0.142	..	0.013	0.008	0.088	1.539	..	..	..	0.084	2.040	..
SOILS NOT IN PUMICE DISTRICT—FOR COMPARISON.																	
D 1123/2	Motuhī Island, Auckland; windmill paddock (greywacke soil; ratstail grass)	20.22	11.12	0.312	..	..	..	0.015	0.003	0.136	0.740	0.790	0.180	0.110	0.110	3.175	..
D 1123/1	Motuhī Island, Auckland; behind windmill paddock	22.20	12.06	0.319	..	..	..	0.016	0.003	0.131	0.650	0.730	0.120	0.080	0.080	3.026	..
D 1124/1	Hauraki Plains (Shelly Beach)	44.40	16.44	0.481	..	..	..	0.033	0.066	0.227	0.450	0.100	0.370	0.240	0.240	3.304	..
D 1124/2	" (clay paddock)	30.01	10.87	0.597	..	..	..	0.100	0.062	0.273	0.370	0.850	0.330	0.210	0.210	3.000	..
D 1124/3	" Piako River	37.99	15.08	0.422	..	..	..	0.056	0.032	0.324	0.420	0.880	0.330	0.140	0.140	2.542	..

TABLE 2.—MECHANICAL ANALYSES.

(Results are percentages on air-dried soil.)

Laboratory No.	Description of Soil. (Classification of United States Department of Agriculture, modified)	Analysis of "Fine Earth" passing 2 mm Sieve					Moisture and Loss on Ignition.	Stones and Gravel.
		Fine Gravel.	Coarse and Fine Sand.	Silt.	Fine Silt.	Clay.		
PUMICE SOILS OF TYPICAL BUSH-SICK COUNTRY.								
L 94	Coarse sandy soil ..	0.7	40.8	18.0	3.5	2.8	33.9	4.0
C 468/4	" ..	23.3	53.4	10.9	2.4	..	9.3	..
C 825/4	" ..	20.8	56.8	9.1	2.6	..	10.5	..
C 468/1	Fine sandy soil ..	2.0	41.3	32.9	5.7	..	16.3	..
D 36/4	Coarse sandy soil ..	13.1	50.3	12.2	2.9	0.8	19.1	..
D 348/7	Fine sandy soil ..	1.0	39.2	34.7	7.2	..	16.0	..
TYPICAL PUMICE SOILS OF COUNTRY NOT BUSH SICK.								
C 825/7	Fine sandy soil ..	Nil	50.8	24.6	6.1	..	17.3	..
R 979	Medium sandy soil..	2.6	{ 31.2 23.9	18.5	6.2	0.9	13.9	Trace.
NON-PUMICE SOILS, ROTORUA DISTRICT—NOT BUSH SICK.								
D 348/9	Clay loam ..	0.60	{ 12.35 19.88	20.95	13.66	25.59	{ 2.08 2.45	..
C 1317/4A	Fine sandy soil ..	5.47	{ 22.80 35.09	15.01	8.10	6.00	{ 1.49 4.39	..
R 1096*	" ..	6.10	{ 18.30 26.60	18.70	13.40	5.50	{ 2.20 9.70	5.5

* Wairoa Road—for completing D 36/6.

Concerning the chemical composition of the rock from which the Rotorua pumice is derived—rhyolite—this is an acidic (containing a preponderance of acid) volcanic rock, which is naturally low in iron content compared with other volcanic rocks of more basic character (containing more bases or metallic oxides), such as the andesites, basalts, &c. Rhyolite has the same chemical composition as granite, a little over 1 per cent. of iron being present, whereas more basic rocks may contain two or three times this quantity, and basalts as much as 10 per cent. or more. Naturally, the soil derived from a rhyolitic pumice is lower in iron than a soil from a rock richer in iron. It should be remembered that there are different kinds of pumice, and the composition of it is, of course, dependent on the rock from which it is derived. There is, for instance, in Taranaki an andesitic pumice which should contain 8 per cent. of iron. To say that a rock is a pumice—which merely means a volcanic froth—conveys nothing of its composition to a geologist. In these papers, where the distinction is made between pumice soils and rhyolite soils, it must be understood that although both are rhyolites, the pumice soils are derived from the Rotorua pumice-shower, and the rhyolite from the underlying country rock, which is a rhyolite or rhyolitic breccia (a solidified paste of volcanic fragments).

Space limitations dictate that for the present only a small number of soil-analyses can be inserted, according to the accompanying tables. In an attempt to determine what amounts of iron are present as available iron in the soil recourse has been had to the well-known Dyer's method of determining available plant-food in soils. This method extracts iron in much greater amounts than it does other plant-foods,

but no standard has been suggested for iron, and there is no reason why the standard figure should not be a high one compared with those for the other mineral foods—potash and phosphoric acid. The fact remains that the figures for “available” iron in the above analyses of bush-sick soils are much lower on the whole than those for pumice soils upon which bush sickness does not develop, yet both soils have had a common origin, although the subsequent history of one has been different from that of the other. When one turns to non-pumice soils much greater amounts of iron are found, whether these soils be in the midst of the pumice area or whether in areas quite apart. The whole question of the probable influence of iron in bush sickness is so important that a full discussion must be reserved for another number.

(To be continued.)

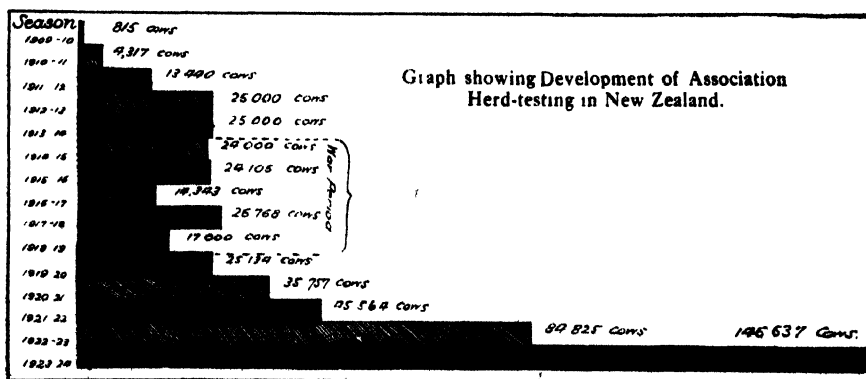
DAIRY-HERD-TESTING ASSOCIATIONS.

DEVELOPMENT IN 1923-24 SEASON.

W. M. SINGLETON, Director of the Dairy Division, Wellington.

THE close of the cow-testing season always invites retrospect—a survey of results, a comparison with the work done in previous years, and an estimate of the position. As was the case in the 1922-23 season, an effort was made to ascertain the number of cows in the Dominion which have been systematically tested on the herd-testing-association principle, and it is pleasing to record that the figures for 1923-24 disclose an increase over the previous season of no less than 73 per cent. The aggregate at date of writing has reached 146,637 cows, as against 84,825 for 1922-23.

To enable readers to see at a glance the progress made since the first association was inaugurated, in the spring of 1909, the accompanying graph has been prepared. There is probably no need to state



that the erratic numbers around the middle years represented were the result of the Great War's influence on labour and general conditions.

The following table gives the figures for the 1923-24 season, and indicates how the movement is represented in the various land districts. The numbers of cows shown in such districts are those of the Agricultural and Pastoral Statistics taken as at 31st January, 1923 the latest available.

Land District.	Number of Dairy Cattle.	Number of Cows tested.	Percentage of Cows tested.	
			1923-24	1922-23
North Auckland .. .	185,870	14,395	7.74	7.36
Auckland	292,520	70,934	24.25	14.35
Gisborne	27,248	3,082	11.31	10.12
Hawke's Bay	50,301	4,391	8.72	3.75
Taranaki	201,758	17,807	8.83	8.34
Wellington	103,815	20,944	15.45	7.29
North Island	951,578	140,553	14.77	9.59
South Island	297,065	6,081	2.05	0.78
Dominion	1,248,643	146,637	11.74	7.46

Of the total of 146,637 cows, officers of the Dairy Division have controlled the testing of 37,378.

The foregoing figures appear very creditable—as they certainly are, but it must be remembered that the cows on test represent only about 12 per cent. of the total number of dairy cows in the Dominion. There is therefore still considerable progress required before the number systematically tested reaches a satisfactory proportion of our dairy-cow population. The number of associations represented is 182 (compared with 137 in 1922-23), and most of these are connected with dairy companies to which the members are suppliers. There are 535 dairy factories in New Zealand, and we consider that the time is coming when herd-testing for yield will be represented among the suppliers to every factory.

As was the case in the previous season, the fact which attracts attention so far as the present statement is concerned is the paucity of cows tested in the South Island. In Otago and Southland alone there are ninety-seven dairy factories, with 114,706 cows supplying them. Yet the whole of the South Island tested less than six thousand cows, and even of these cows 2,038 were tested by officers of the Dairy Division. It would be satisfactory to see South Island dairy-farmers take a more active interest in testing—because the benefits affect first of all their own incomes and afterwards the country as a whole—and to find next season bringing forward many new cow-testing associations in that part of the Dominion, each with a satisfactory membership. It is recognized, of course, that some districts are more suited for dairying than others, and that the North Island specializes more in dairy-farming than the South. At the same time we firmly believe that the suppliers to every dairy factory should have an arrangement whereby their cows are systematically tested.

THE OFFICIAL SEED-TESTING STATION.

RECORD OF OPERATIONS IN 1923-24.

NELSON R. FOY, Seed Analyst, Biological Laboratory, Wellington.

THE work of the Department's seed-testing station, at Wellington, was well maintained during the twelve months ended 31st March, 1924, 9,100 samples being tested for germination and 1,526 for purity, compared with 9,056 and 1,500 respectively handled during the previous year. Some 600 miscellaneous laboratory tests were also made in 1923-24. As usual the great bulk of the routine testing was of samples forwarded by the seed trade, only some 120 samples having been received from farmers. This points to confidence in the ability and desire of the trade as a whole to supply good seed. Many firms now furnish germination figures with parcels of seed, and in most cases farmers who buy questionable seed or deal with other than reputable houses have only themselves to blame for any bad results.

The movement of seed-testing throughout the year is shown in Table 1. Two periods of special activity are indicated—one in July and August, representing preparations for spring sowings and stock-takings; the other in February and March, representing the new season's grasses and clovers.

The number of samples received of the various species (Table 2) is of interest in that it shows where lie the greatest activities of the seed-trade in New Zealand. The small number of cereal samples tested is rather surprising, and suggests that more attention might be paid by farmers to the viability of their cereal seeds.

GRASSES.

The purity and germination of the main species of grasses tested at the station, together with their main impurities, are shown in Tables 3 and 4, which furnish many points of interest.

Perennial Rye-grass.—The average germination of 81 per cent. may be considered very satisfactory. The average growths of the seed from the different rye-grass districts were as follows: Poverty Bay, 93 per cent.; Hawke's Bay, 92.7; Sandon (Manawatu), 80.5; Canterbury, 87.4; Southern, 80.1. This season's (1924) Southern, Canterbury, and Sandon seed shows a distinct improvement on last year's figures, the extremely dry harvesting season apparently being in its favour. A total of forty species of impurities were found in the samples generally, the chief among them being hair-grass, goose-grass, and catsear, which are among the commonest of the undesirables in our pastures. Ergot was present in the season's seed to a greater extent than is usual. Two samples of seconds contained Californian thistle.

Table 1.—Number of Samples received throughout the Year

Month.	Number.	Month.	Number.
1923—April	589	1923—October	648
May	829	November	574
June	912	December	462
July	978	1924—January	478
August	1,214	February	774
September	796	March	846

Table 2.—Number of the various Species tested

Lucerne	97	Cocksfoot	610
Alsike	74	Paspalum	34
White clover	325	Poa pratensis	46
Cow-grass and red clover	405	Prairie-grass	21
Crimson clover	35	Other grasses	160
English trefoil	34	Japanese millet	40
Lotus major	63	Oats	42
Other clovers	36	Other cereals	18
Perennial rye-grass	1,537	Mangolds	184
Italian rye-grass	370	Turnips	413
Western Wolths	201	Swedes	278
Timothy	76	Rape	145
Crested dogstail	90	Kale	48
Danthonia spp	81	Tree-seeds	16
Brown-top (<i>Agrostis tenuis</i>)	78	Flower seeds	20
Chewings fescue	524	Vegetable seeds (other than peas)	325
Meadow fescue	35	Peas	179
Meadow foxtail	43	Other leguminous herbage plants	26

Table 3.—Percentage of Purity and Germination of Grasses.

	Average Percentage of Impurities.	Percentage of Samples containing Noxious Weeds.*	Percentage of Germinations.			Percentage of Samples germinating between						
			Highest.	Lowest.	Average.	0-50 %.	51-60 %.	61-70 %.	71-80 %.	81-90 %.	91-100 %.	
Perennial rye-grass ..	0.8	1.5	100	0	81.1	4.0	4.0	10.7	24.8	33.3	23.3	
Italian rye-grass ..	0.2	..	99	14	80.4	2.0	2.5	7.5	18.6	24.2	50.4	
Western Wolths ..	0.5	5.0	100	21	80.2	6.2	5.6	4.8	11.2	20.4	53.2	
Timothy ..	0.3	0.5	100	46	94.0	1.2	..	..	4.6	11.3	84.7
Crested dogstail ..	1.0	10.0	100	3	89.6	2.1	2.3	3.9	5.3	15.2	73.4	
Cocksfoot ..	1.7	7.0	98	0	67.3	13.2	12.3	27.3	28.6	14.9	6.6	
Brown-top† ..	3.6	7.0	89	39	81.6	4.0	10.2	8.6	14.7	36.4	26.8	
Chewings fescue ..	1.1	6.0	100	1	86.4	2.1	2.0	4.6	10.5	29.6	52.3	
Meadow fescue ..	..	..	97	2	60.2	4.0	2.8	2.8	14.2	17.0	22.8
Poa pratensis ..	0.5	2.0	83	14	55.2	3.6	34.0	20.2	13.3	3.9	..	
Meadow foxtail ..	..	..	63	3	31.3	23.2	25.5	34.9	11.6	1.6	..
Danthonia spp. ..	13.5	1.5	81	1	39.2	24.0	16.4	18.6	18.0	10.5	15.5	
Paspalum ..	..	..	59	0	24.5	54.2	20.8	6.5	7.4	3.5	6.0

* Those species mentioned in the Act, other than docks and sorrel.

† Average percentage of husk, 34.0—highest, 70.0; lowest, 8.7.

Table 4. —Occurrence of the Main Impurities of the Grasses.

(The figures are percentages of samples in which the various impurities occurred.)

	Perennial Rye-grass.	Italian Rye- grass.	Western Wolths.	Timothy.	Crested Dogstail.	Cocksfoot.	Brown-top.	Chewings Fescue.	Danthonia Spp.
Hair-grass ..	72	74	73	..	14	11	25	41	100
Goose-grass ..	53	60	74	..	..	61	..	11	20
Catsear ..	30	15	10	..	42	30	40	88	36
Perennial rye-grass ..	..	..	..	..	70	89	8	66	43
Sweet vernal ..	8	3	6	..	38	5	23	36	57
Rib-grass ..	15	15	20	25	14	42	41	1	36
Yorkshire fog ..	11	7	14	10	74	46	14	54	38
Sorrel ..	24	34	47	50	4	18	32	17	2
Curled dock ..	5	3	6	..	..	18	4	1	4
White clover ..	15	12	14	50	15	12	40	6	7
Creeping buttercup ..	2	3	..	..	..	14	..	..	1
Californian thistle ..	1	2	6	..	8	..	..	1	..
Hawkweed ..	..	..	..	..	10	..	4	..	..
Ergot sclerotia ..	31	24	7	10	15	7	68	9	..
Oxe-eye daisy ..	..	..	..	..	1	2	..	..	..
Cocksfoot ..	14	5	..	..	1	..	4	16	6
Fat-hen ..	..	..	7	25	..	3	..	..	..
Italian rye-grass ..	62	..	..	..	..	2	..	..	10
Suckling clover ..	19	26	40	..	14	2	19	3	4
Crested dogstail ..	21	10	..	10	..	2	23	10	2
Chickweed ..	..	3	7	..	22	2	..	1	..
Field madder ..	2	5	6	..	..	1	..	..	..
Alsike ..	7	3	1	100	4	..	..	1	2
Lotus spp. ..	1	..	..	..	1	..	80	..	2

Italian Rye-grass and Western Wolths.—The remarks concerning the germination and purity of perennial rye-grass apply equally to Italian and Western Wolths. Californian thistle was found to a greater extent than in perennial rye-grass. Italian contained twenty-eight species of impurities and Western Wolths twenty-two.

Timothy.—Practically all imported timothy seed was of good quality and unusually free from harmful impurities. Some excellent samples of seed grown in Southland were received. Timothy contained only twelve species of impurities, the chief of which were alsike and sorrel.

Crested Dogstail.—An average growth of 90 per cent. is very satisfactory. Last season's seed was of excellent quality, more than 70 per cent. of the samples germinating over 90 per cent. (average 97 per cent.) This season's southern seed is not so good, the dry season evidently "ripening" the seed off before it had fully matured. Early in the season most of the seed failed to grow much over 60 to 70 per cent., but maturity is now complete and the seed gives an average growth of 86 per cent. It is of a light canary-yellow colour (so desired by many farmers), in contrast to the dark coppery colour of really good dogstail. Rye-grass, Yorkshire fog, sweet vernal, and catsear were the main impurities. Californian thistle was found to be present in some of the samples, but it is not so common as it was some years ago. Dogstail contained thirty-seven species of impurities.

Danthonia spp..—An average of 39 per cent. germination is only fair for *Danthonia*. Most of the samples were of *D. pilosa*, although nearly all contained the smaller *D. semiannularis* in varying quantities, from 1 per cent. to 50 per cent. All the samples contained hair-grass from 2 per cent. up. One sample received, labelled "*Danthonia*," consisted of *D. pilosa*, 2 per cent.; hair-grass, 97 per cent.; and other extraneous seeds, 1 per cent. Sweet vernal, rye-grass, rib-grass, and catsear were the chief additional impurities. Many samples contained from 5 per cent. to 15 per cent. of inert matter (straws, &c.), a good deal of which could easily be dressed out. *Danthonia* contained only thirteen species of impurities.

Brown-top (Agrostis tenuis).—An average growth of 81 per cent. is good for brown-top. Much of this seed is sold in a rough unblown state, while the germination tests are made on fully developed mature seed. Quantities of seed of excellent quality are now being saved in Southland, and this it is hoped will attract attention in foreign markets. Waipu brown-top contained an average percentage of 34 per cent. of husk, with a maximum of 70 per cent.; southern seed contained 5 to 10 per cent. The percentage of impurities is also much lower in southern, the heavy-weighting *Lotus spp.* of the northern seed being entirely absent. The chief impurities of Waipu seed are the *Lotus spp.* (mainly *L. major* and *L. hispidus*), rib-grass, white clover, catsear, and sweet vernal; and those of southern seed small percentages of yarrow, and mouse-eared chickweed. Brown-top contained twenty-four species of impurities.

Chewings fescue.—The season's Chewings fescue (average germination 86.4 per cent.) was of good average quality. Last season's seed was particularly above the average, and constituted one of the finest crops taken from Southland for many years. This season's seed is not so good, and the indications are that it will not stand shipping overseas as well as did that of 1923. On the other hand, 1924 seed is cleaner; being harvested early it missed the seeding of the later flowering catsear—the "price dropper" of Chewings fescue. Catsear occurred in nearly 90 per cent. of the samples, while rye-grass, Yorkshire fog, and hair-grass were the additional most common impurities among the twenty-nine species met with. Californian thistle was found to be present in a few samples, but only to a limited extent.

Cocksfoot.—An average growth of 67 per cent. can be taken as being very satisfactory. Considerable quantities of Danish seed were imported during the year. This seed gave varying germination results, ranging from 10 per cent. to 97 per cent., with an average of 73 per cent. It would appear that much of the lower grade seed was being dumped from an overloaded overseas market. Of the colonial seed Akaroa gave an average of 67 per cent., and Plains (Canterbury) an average of 78 per cent. Of the whole of the cocksfoot tested 97 per cent. contained empty glumes. The percentage (by numbers) ranged from 1 per cent. to 85 per cent., and 8.5 per cent. of the samples contained over 20 per cent. of empty glumes, the average being 10.4 per cent. Cocksfoot contained fifty-seven species of extraneous seeds, the chief of which were: New-Zealand-grown—rye-grass, Yorkshire fog, goose-grass, rib-grass, and catsear; imported (in addition to those mentioned for New

Zealand)—Creeping buttercup, field foxtail, night-flowering catchfly, tall fescue, and field chamomile. A few of the imported samples (2 per cent.) contained ox-eye daisy.

Paspalum dilatum.—An average growth of 24.5 per cent. for *Paspalum* is only fair. Over 50 per cent. of the samples germinated under 20 per cent. and 6 per cent. over 60 per cent. Most of the seed was of Australian origin, and the new season's seed now coming on to the market is giving some very fine results—much of it being over 50 per cent. growth. New Zealand seed is very poor, and is mainly responsible for the low germination percentage. No purity tests were made.

Poa pratensis.—All imported seed was of fair average quality. Eleven species of weed seeds occurred, the chief of which were white clover, sorrel, mouse-eared chickweed, and sedge species.

Other Grasses (Table 2) include red-top (86 per cent. average germination), yarrow (84 per cent.), Indian Doob (84 per cent.), tall oat-grass (75 per cent.), *Poa trivialis* (85 per cent.), and Yorkshire fog (90 per cent.).

CLOVERS AND OTHER LEGUMES.

The percentage of purity and germination of the main clovers and other leguminous herbage plants is shown in the following table:—

Table 5.—Percentage of Purity and Germination of the Main Clovers, &c.

	Average Percentage of Impurities.	Percentage of Samples containing Noxious Weeds.	Percentage of Germination.			Percentage of Samples germinating between						
			Highest.	Lowest.	Average.	0-50 %.	51-60 %.	61-70 %.	71-80 %.	81-90 %.	91-100 %.	
White clover ..	4.2	25.0	100	10	88.3	3.7	1.8	1.8	4.9	32.6	55.0	
Alsike ..	0.9	25.0	98	13	87.0	2.7	2.7	4.0	8.0	23.0	60.0	
Cow-grass ..	0.6	30.0	100	8	90.8	2.3	1.0	1.6	1.8	16.9	76.3	
Lucerne ..	0.1	100	51	51	91.6	..	2.2	1.1	7.7	25.2	63.7	
English trefoil ..	0.6	..	97	4	67.2	21.2	9.9	12.1	12.1	12.1	33.3	
Crimson clover ..	1.2	2.0	100	7	84.1	6.3	6.3	3.2	6.3	6.3	71.0	
Lotus major ..	9.2	25.0	99	38	78.5	3.2	16.0	11.1	19.0	31.7	19.0	

White Clover.—An average germination of 88.3 per cent. can be considered good. More than half of the samples germinated over 90 per cent., and the germination of the majority of those samples growing between 80 and 90 per cent. was lowered by the hard-seed content. The highest percentage of hard seeds was 43, and the average for the whole of the samples tested was 10 per cent. Sixty-two species of extraneous seeds occurred in white clover. Of these the main ones were suckling clover (occurring in 94 per cent. of the samples), alsike (82 per cent.), sorrel (81 per cent.), rib-grass (75 per cent.), cow-grass (68 per cent.), fat-hen (42 per cent.), haresfoot trefoil (35 per cent.), and scarlet pimpernel (30 per cent.). Dodder occurred in 5 per cent. of the samples examined; the highest rate of occurrence was 2,000

seeds per pound, and the lowest five. In only four samples did the amount of dodder exceed 100 seeds per pound. The highest percentage of impurities was 49 per cent., composed mainly of suckling clover and sorrel.

Alsike.—The average germination was 87 per cent., the samples being mainly of imported seed. The percentage of hard seeds—5 per cent.—was lower than that of white clover. Twenty species of impurities were found in alsike, the chief of which were white clover (in 87 per cent. of the samples), English trefoil (87 per cent.), Timothy (86 per cent.), cow-grass (50 per cent.), suckling clover (25 per cent.), and Californian thistle (12 per cent.).

Cow-grass and Red Clover.—The average germination was 90·8 per cent. The bulk of this seed was of colonial origin, only a few imported lines being examined. The New Zealand seed was of a much finer type and very much cleaner than the imported. The highest percentage of hard seeds was 51 per cent., and the average 5 per cent. Fifty-eight species of impurities were found, including rib-grass (in 91 per cent. of the samples), white clover (50 per cent.), alsike (26 per cent.), curled dock (28 per cent.), sorrel (28 per cent.), and fat-hen (20 per cent.). Californian thistle occurred in 4 per cent. of the samples, and dodder in 6 per cent. These two impurities were found only in imported seed, at the average rate of 40 seeds per pound.

Lucerne.—Seed germinated very well on the average, and contained very few impurities. Nine species of impurities occurred, the main ones being rib-grass (in 75 per cent.), cow-grass (62 per cent.), fat-hen (38 per cent.), and *Melilotus* spp. (25 per cent.). This last-named is taken as an indicator for Marlborough seed. Lucerne contained on the average 5 per cent. of hard seeds. Dodder did not occur in any of the samples.

English Trefoil.—This seed did not grow well, showing an average of 67·2 per cent., with only 1 per cent. of hard seeds. Seven species of impurities occurred, the chief being rib-grass, red clover, field madder, and the cranesbills.

Crimson Clover.—The samples tested were either very low or very high, there being no intermediate lines. Hard seeds were entirely absent. Thirty-one species of impurities occurred, twenty-three of which were found in one sample. English trefoil (in 60 per cent.), field madder (60 per cent.), sorrel (50 per cent.), cut-leaved cranesbill (40 per cent.), and night-flowering catchfly (25 per cent.), were the principal species. Dodder did not occur, and Californian thistle was found in one sample only.

Lotus major.—An average growth of 84·1 per cent. can be considered satisfactory for this seed. The samples contained on an average 20 per cent. of hard seeds, with a maximum of 75 per cent. Only 6 per cent. of the samples did not contain hard seeds. Thirty-seven species of impurities occurred, with the rather high average percentage of 9·2. Nearly one-half of the samples contained *L. hispidus* (*L. angustissimus* of the seed-trade), from 1 per cent. to over 50 per cent. The chief impurities were white clover (in 100 per cent.), rib-grass (84 per cent.), sorrel (75 per cent.), suckling clover (75 per cent.), sweet vernal (75 per cent.), selfheal, spurrey, Yorkshire fog (50 per cent.), and dodder (25 per cent.).

cent.). Practically all the samples containing dodder were of imported seed, which, although it does not contain the other *Lotus* spp., is always more impure than colonial seed. One sample examined contained dodder at the rate of 91,000 seeds per pound, which must be considered a record for dodder content so far as this station is concerned. Some of the finest *Lotus* major which has ever come under the notice of the writer has been produced in Southland this season. It is practically pure, well formed, and of a beautiful colour.

Other Clovers, &c. (Table 2), include strawberry clover (80.6 per cent. average germination), subterranean clover (65 per cent.), Berseem clover (90 per cent.), suckling clover (70 per cent.), *Lotus hispidus* (77 per cent.), *L. corniculatus* (60 per cent.), sainfoin (35 per cent.), serradella (65 per cent.), King Island melilot (65 per cent.), and sand clover (75 per cent.).

ROOTS AND CRUCIFEROUS FORAGES.

The following table shows the percentage of germination of the main roots and cruciferous forage plants. :—

Table 6 —Percentage of Purity and Germination of the Main Roots and Cruciferous Forage Crops.

	Percentage of Impurities.	Percentage of Germination.			Percentage of Samples germinating between					
		Highest.	Lowest.	Average.	0-50 %.	51-60 %.	61-70 %.	71-80 %.	81-90 %.	91-100 %.
Turnips ..	0.1	100	13	90.2	2.8	2.4	3.7	7.0	20.0	64.0
Swedes ..	0.1	100	2	84.5	3.7	2.5	6.6	16.4	22.7	47.9
Rape ..	0.1	100	35	91.4	2.6	1.3	2.6	2.0	16.0	75.3
Kale ..	0.1	100	39	89.8	4.1	4.1	..	4.1	25.0	62.5
Mangolds ..	0.1	24.0	43	151.1	1.50 %.	51-100 %.	101-150 %.	151-200 %.	201-250 %.	251-300 %.
					0.9	13.5	48.3	34.8	2.4	..

Turnip and Swede Turnip seed germinated very well, giving an average of 90 per cent. Swedes were a little lower—84.5 per cent.—which can be considered a fair average. Both these seeds are always very pure and contain only small percentages of cleavers and bindweed. Several graphited lines were noticed, but in all cases the seed was true to label. The mixing of very old with new seed was also found to be not uncommon.

Rape seed gave the satisfactory average growth of 91.4 per cent. Impurities were as for turnips and swedes.

Kale seed is usually not so vigorous as rape, &c., so that 89.8 per cent. can be considered a very good average result. Impurities were also as for turnips.

Mangolds.—An average of 151.1 per cent. is very satisfactory. Less than 15 per cent. of the samples germinated under 100 per cent. (Germination of mangolds is expressed in terms of the number of seedlings

per 100 clusters.) Few impurities were noticed—cleavers, curled dock, and bindweed being the main ones.

Carrots gave the fair average germination of 70 per cent.

MISCELLANEOUS FORAGES.

Average germinations of those tested were : Japanese millet, 92 per cent. ; maize, 90 per cent. ; sorghum, 70 per cent.

CEREALS.

Average germinations recorded were as follows : Oats, 85 per cent. ; barley, 84 per cent. ; wheat, 88 per cent. ; rye-corn, 90 per cent.

PEAS, BEANS, AND TARES.

All these seeds germinated well, the respective averages being 93, 92, and 90 per cent. All the peas and beans tested were colonial grown, and were of excellent quality and appearance. A few very poor samples of tares and vetches were received.

VEGETABLES.

Over thirty varieties (325 samples) of vegetables seeds were tested and, with the exception of a few obviously old lines, all gave good results.

PASTURE MIXTURES.

Over twenty of these mixtures were tested and examined during the year. The majority were forwarded by farmers who had failed to obtain a strike. On the whole, the results tended to show that the fault did not lie with the seed. Some of the samples, however, were of the "auction-room" variety, and were actually worth much less than the low price paid for them. One "bargain" made by a farmer at 5d. per pound gave the following analysis :—

	Percentage of Sample.	Germination Percentage.
Rye-grass	10	56
White clover, cow-grass, alsike	5	74 (average).
Cocksfoot, dogstail, <i>Poa pratensis</i>	5	42 (average).
Rib-grass	65	..
Other weed-seeds (35 species)	15	..
	100	

The value of the useful seed (20 per cent.) present was actually less than 2d. per pound. It is well that lines such as this are rare. The strange part of it is that there are always willing purchasers for such seed.

CONCLUSION.

On comparing the foregoing data with those of a similar nature of other countries it is evident that the seed handled by the New Zealand trade is of a high standard in general, and that it is the honest endeavour of the majority of our seed-merchants to supply the best.

NOTE.—Credit is due to Mr. W. J. Cooch, of the seed-station staff, for the compilation of most of the figures used in this article.

THE BEST STAGE FOR CUTTING WHEAT.

FURTHER EXPERIMENT AT LINCOLN.

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LAST year Dr. F. W. Hilgendorf and the writer made a determination, by the statistical method, of the earliest stage at which wheat could be cut without loss of weight by shrivelling, the result being recorded in this *Journal* for June, 1923. That stage was the one denominated "C" in the trials referred to.

This year the trial was repeated on the same plan, using a crop of College Hunters in place of the Solid-straw Tuscan. The indications given last year were so plain that it was considered sufficient on this occasion to observe only stage C, and those immediately previous to and following it, omitting the extreme stages A and E. The result of the weighings was as follows:—

Average Weight of 100 Grains of Wheat cut at different Stages of Ripeness.

Stage B . . . . .	..	4.645 ± 0.028 grammes.
Stage C (three days later than B)	..	4.794 ± 0.038 grammes.
Stage D (three days later than C)	..	4.790 ± 0.041 grammes.

This is exactly the result obtained last year. The difference between the weights of 100 grains cut at stages B and C is 0.149 grammes, and the "probable error" of that difference is 0.047 grammes. Since the difference is more than three times the probable error, we have a forty-to-one chance that the difference is a real one and not due to the vagaries of sampling. The difference in weight between stages C and D is less than the probable error, and therefore is only such a difference as might be expected from various samples of the same material. We thus conclude with certainty that the crop increases in weight up to stage C—that cutting before that leads to loss by shrivelling, while waiting after that results in no gain in weight but only in risk of loss by shaking.

The method of the experiment, and the use of the "theory of probabilities," were explained in more detail in the former article.

Stage C is thus described: General aspect of the crop ripe-coloured but close scrutiny revealed a tinge of green. Straws all yellow except about 1 per cent., which showed 3 in. of green above the topmost knot. Knots all green. Heads all ripe-coloured except about 1 per cent. still green. Grains in the riper heads so firm that no kind of milk or dough could be squeezed out of them, but soft enough to cut easily with the thumb-nail.

The interest of the experiment is not merely that it defines exactly the stage at which wheat should be cut. It confirms last year's trial, and emphasizes the utility of the statistical method of investigating agricultural experiments, even when these are concerned with abstruse questions involving elusive differences.

TESTING OF NEW-ZEALAND-GROWN WHEATS.

A FURTHER SERIES OF SAMPLES.

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I. MILLING-QUALITIES.

A FURTHER series of wheat-samples has recently been tested at the Department's Chemical Laboratory, and the milling-qualities of the various wheats determined. Work on the strength or quality of the flours obtained is proceeding.

The samples received differed considerably from those tested last year,* many being of lesser known varieties. Six samples of Velvet and about a dozen of the different Tuscan were received. On the other hand, a number of samples of interesting varieties were obtained from different sources; the majority of these came from the Ashburton Experimental Farm. No samples were received from Tuapeka and the Upper Taieri, districts which previously have sent in excellent wheats. Three samples of Yeoman were obtained. This variety is a comparatively new wheat which is gaining a certain amount of popularity in England on account of its good all-round qualities. According to the "Interim Report on Cereals, Bread, and Flour" (Ministry of Agriculture and Fisheries, London, 1923), Yeoman crops heavily on typical wheat soils, possesses a good straw, and, above all, possesses strength sufficient to permit the miller to make good bread-flour from it without the admixture of foreign wheat. Since climatic conditions in England and parts of New Zealand are somewhat similar, it is possible that Yeoman grown here may retain those qualities which are enabling it to compete favourably in England with the strong wheats imported from Canada and elsewhere. Among the other wheats are several which are said to possess good strength when grown in the country of their origin.

This year the weight per bushel has been calculated, and should prove of interest when compared with the other properties of the different samples. These calculated weights are relative only, though care has been taken to make them as accurate as possible.

It will be noticed from the accompanying tabulated statement that some of the varieties were harvested in 1923 and some during the current year. Since wheats and flours improve in strength and baking-qualities when stored even up to three and four years, it is necessary to keep this in mind when comparing the different seasons' samples. It is not known whether the yield of flour of local wheats is affected by storage beyond a reasonable length of time.

Some of the wheats were more difficult to mill than is usually the case. As this defect was confined to the samples collected from the 1923 harvest, it would appear that it was due to some peculiarity in the climatic conditions of that wheat-growing season. As each variety

* See *Journal* for July, August, and September, 1923.

Table I. *Milling Tests of New Zealand-grown Wheats (Second Series).*

Laboratory No.	Variety.	Where grown.		Year harvested.	Date of Milling.	Calculated Weight per Bushel.	Milling Test.			Remarks on Yield of Flour.
		Locality.	County.				Bran.	Pollard.	Flour.	
						lb.	Per Cent.	Per Cent.	Per Cent.	
R 1200	Velvet	..	Ashburton	..	16/4/24	64.2	11.6	15.3	73.1	Very good.
R 1189	"	"	"	..	4/4/24	62	8.1	19.0	72.9	Good
R 537	"	Pukeuri	Waitaki	1924	22/3/24	63	10.4	17.1	72.5	"
R 1201	"	Lincoln	Springs	1924	14/4/24	66	12.0	16.3	71.7	"
R 746	"	Gibbston	Lake	1923	2/4/24	65.2	10.9	18.5	70.6	Medium
R 539	"	Fairlie	Mackenzie	1923	24/3/24	63	11.4	18.6	70.0	"
R 1210	College Hunters	Lincoln	Springs	1924	3/5/24	66	9.8	15.8	74.4	Very good.
R 538	"	Rangitata	Geraldine	1923	24/3/24	64	12.0	14.6	73.4	"
R 744	Tuscan	Pembroke	Lake	1923	31/3/24	65	8.0	20.1	71.9	Good
R 542	"	Waitawa	Levels	1923	27/3/24	62	9.9	19.6	70.5	Medium.
R 748	"	Arrowtown	Lake	1923	4/4/24	65.2	8.4	21.4	33.2	"
R 747	"	Crown Terrace	"	1923	3/4/24	65.2	10.7	21.3	68.0	"
R 745	"	Lake Hayes	"	1923	1/4/24	64.2	10.8	22.1	67.1	"
R 1193	White-straw Tuscan	Ashburton	Ashburton	1924	10/4/24	65.2	11.9	12.4	75.7	Very good.
R 726	Ditto (improved)	Seddon	Awatere	1923	6/5/24	64.2	11.9	13.6	74.5	"
R 727	White-straw Tuscan	"	"	1923	6/5/24	62	14.7	12.9	72.4	Good.
R 1208	Solid-straw Tuscan	Rakaia	Ashburton	1924	2/5/24	63.2	10.6	17.0	72.4	"
R 1203	"	"	"	1924	16/4/24	65	11.2	16.7	72.1	"
R 825	"	Cust	Rangiora	1923	11/3/24	63	11.6	18.3	70.1	Weathered sample
R 824	"	"	"	1923	10/3/24	62.2	10.9	19.8	69.3	Ditto.
R 535	"	Glenavy	Waimate	1923	21/3/24	61	12.5	18.3	69.2	"

R	826	Solid-straw Tuscan	Hawkins	Malvern	1923	11 3/24	59	15.2	20.2	64.6	Badly weathered sample.
R 1209	Victor	..	Horrelville	Eyre	1924	2 5/24	632	11.9	11.0	77.1	Excellent.
R 543	"	..	Temuka	Geraldine	1923	28 3/24	622	9.7	17.3	73.0	Good.
S 16	Yeoman	..	Marton	Rangitikei	1924	7 5/24	65	12.3	14.7	73.0	"
R 1204	"	..	Lincoln	Springs	1924	22.4/24	64	9.9	18.1	72.0	"
R 1205	"	..	Irwell	Ellesmere	1924	22 4/24	652	11.0	17.2	71.8	"
R 541	Dreadnought	..	Studholme	Waimate	1923	27 3/24	652	7.3	19.8	72.9	"
R 536	"	..	Weston	Waitaki	1923	21 3/24	63	10.2	17.3	72.5	"
S 17	Major	..	Marton	Rangitikei	1924	7 5/24	65	10.7	14.9	74.4	Very good.
R 1195	"	..	Ashburton	Ashburton	1924	11 4/24	642	11.2	14.7	74.1	"
<i>Miscellaneous</i>											
R 1190	Queen Fair	..	Ashburton	Ashburton	1924	9 4/24	65	9.4	13.8	70.8	Excellent.
R 1207	Hybrid W	..	Horrelville	Eyre	1924	1 5/24	62	11.2	13.2	75.6	Very good.
R 1191	Turretfield Eclipse	..	Ashburton	Ashburton	1924	9 4/24	63	10.0	14.7	75.3	"
R 1202	Bordier (College)	..	Lincoln	Springs	1924	16 4/24	65	10.7	15.3	74.0	"
R 1192	Marquis	..	Ashburton	Ashburton	1924	10 4/24	662	9.9	16.4	73.7	"
R 1199	Zealand	..	"	"	1924	15 4/24	67	9.2	17.3	73.5	"
R 1194	Queen Fan	..	"	"	1924	11 4/24	662	8.8	18.5	72.7	Good.
R 1196	Red Fife	..	"	"	1924	11 4/24	66	9.5	18.6	71.9	"
R 1206	Snowdrop	..	Horrelville	Eyre	1924	23 4/24	622	12.5	16.1	71.4	Medium.
R 1197	Comeback	..	Ashburton	Ashburton	1924	12 4/24	66	9.0	19.8	71.2	"
R 540	Red Straw	..	Fairlie	Mackenzie	1923	25 3/24	63	10.4	18.5	71.1	"
R 737	Burbank's Super	..	Omih	Rangiora	1923	31 3/24	642	7.0	23.0	70.0	"
R 1198	Essex Conqueror	..	Ashburton	Ashburton	1924	15 4/24	62	10.6	21.2	68.2	"

NOTE.—All Ashburton samples were grown at the Ashburton Experimental Farm, and Lincoln samples on the Canterbury Agricultural College farm.

was more or less similarly affected, no importance need be attached to the difficulties experienced in milling, and no note is made of any such defects in the statement of results.

Finally, it seems necessary to mention that the colour of flour obtained in the experimental mill cannot be expected to compare with that of the commercial article. This fact has always been realized in all laboratory testing of wheats, and could hardly be otherwise when one knows that it is necessary in experimental milling to run the materials through to the end in each operation, and afterwards to brush out thoroughly the inside of each compartment as well as the sifting-apparatus. This is necessary to prevent any mixture of one variety with another. The results, however, are still comparative.

NOTES ON THE TABULATED RESULTS.

The samples of Velvet compared favourably with those tested last year. Four ranged from good to very good in the amount of flour obtained, and the remaining two were fair.

The two samples of College Hunters tested both gave very good percentages of flour.

The wheats labelled "Tuscan" were below the average for that variety in the amount of flour which they yielded. Two samples of White-straw Tuscan gave 75.7 per cent. and 74.5 per cent. of flour respectively, which must be considered very good; the other sample of the same variety gave a good yield of 72.4 per cent.

Solid-straw Tuscan did not show up as well as previously, but this is due to three of the samples—R 825, 824, and 826—being weathered and more or less unfit for milling. They were tested, not as representative samples, but in order to ascertain the effect of weathering on the yield and the strength of the resultant flour. The first two samples, R 825 and 824, which were only moderately affected, gave rather poor yields of flour; the third, R 826, gave the very poor amount of 64.6 per cent.

Victor, as usual, gave good percentages of flour, a sample from Horrelville, R 1209, giving the rather remarkable amount of 77.1 per cent.

The three samples of Yeoman each gave good amounts of flour. Two lots of Dreadnought were also good. This variety is said by some millers to be unsuitable for milling; by others it is used in large quantities. This may be due to differences in the variety when grown in different districts, but the samples milled in this Laboratory have behaved quite satisfactorily in the mill, and the resultant flour is generally above the average in strength.

The two samples of Major produced very good yields of flour, and gave no trouble at all in the mill. As will be seen, one of these samples was grown near Marton, Rangitikei County, and the other at the Ashburton Experimental Farm.

The miscellaneous samples were grown mostly in Canterbury. Queen Fair gave the excellent yield of 76.8 per cent. of flour, followed closely by Hybrid W. with 75.6 per cent., and Turretville Eclipse with 75.3 per cent. There is little to choose in this respect between these three samples, but, to maintain a uniform classification of flour-yields, percentages above 76.0 are provisionally classified as excellent, and

those above 73.0 per cent. as very good. Hence Queen Fair, though little better than the next sample, is placed in the former class. Bordier, Marquis, and Zealand all gave very good yields of flour, and Queen Fan and Red Fife were good in this respect. The rest, with the exception of a sample of Essex Conqueror, which was poor, were medium milling samples.

WEIGHT PER BUSHEL.

Contrary to results which have sometimes been obtained elsewhere, no close correlation between weight per bushel and yield of flour was observed in the wheats specified in the tabulation. Only among the Solid-straw Tuscan samples is there any apparent connection, and even here an exception must be made of the first sample, R 1208. With the wheats Victor, Yeoman, Dreadnought, and Major there does appear to be a certain parallel, but because of the small number of each variety examined the relationship is probably more apparent than real. Little connection can be seen between these two properties in the miscellaneous samples. At the same time the calculated weight per bushel should prove an additional factor in estimating the relative values of the different wheats.

SUMMARY.

The samples of Velvet recently tested maintained a good average percentage of flour on milling. Tuscan (1923 harvest) seemed lower than usual in this respect, but only five samples were tested. The average of three samples of White-straw Tuscan was very good. Weathered samples of Solid-straw Tuscan gave low results. The few samples of Victor, Yeoman, Dreadnought, and Major gave from good to very good yields of flour, the amounts obtained being well above the average. The miscellaneous samples, with few exceptions, were very good. The wheats tested this year have as a whole yielded good percentages of flour.

As regards the wheat-growing districts no very apparent differences were observed. Canterbury wheats, of which a number were tested, possessed in a majority of cases good milling-qualities. Several samples received from Awatere and Rangitikei Counties gave in each case good yields of flour. The samples from the Lakes district did not appear to be as good as usual.

The calculated weight per bushel of the samples tested did not appear to be generally correlated with the yield of flour.

Proved Seed.—Strains of seeds of proved yielding-capacity are always worth buying, even though the price may be somewhat above that of ordinary samples. It behoves the progressive farmer to make arrangement for his seeds early, so as to avoid delay at sowing-time.

Cleaning out Drains.—A scythe-blade fitted on a long straight handle is useful for cutting grass and rubbish growing on the sides of open drains on the farm. The work can be done more expeditiously with it than with a hook or the slashers usually used.

GRADING OF EXPORT BUTTER AND CHEESE.

LEADING FACTORY AVERAGES FOR 1923-24.

FOLLOWING the practice initiated last year the Dairy Division has compiled for the *Journal* a list of the leading grading averages of butter and cheese factories throughout the Dominion, covering the official year 1923-24. In the previous year's list (published in the *Journal* for July, 1923) the factories were grouped under their respective district grading-stations. On the present occasion, for more convenient general reference and comparison, they are arranged in one consecutive Dominion list as below. It may be mentioned for the information of readers unconnected with the dairy industry that under the official grading system the points for first-grade butter and cheese run from 88 to 100.

BUTTER-FACTORIES WITH AN AVERAGE GRADE OF 92 POINTS AND OVER FOR YEAR ENDED 31st MARCH, 1924.

Name of Company.	Registered Number	Brand.	Average Grade.
			Points.
Maketawa	342	M.D.C.	94.08
Waitaki	812	Waitaki	94.52
Midhurst	110	Rugby	94.47
Bell Block	488	Bell Block	94.44
Mells	764	Mells	94.16
Tarurutangi	728	Champion	94.09
Rata	938	Rata	93.87
Rongotea	8	Rongotea	93.82
Wangaehu	1326	Wangaehu	93.46
Akaroa	1579	Akaroa	93.66
Mangorei	345	Mangorei	93.58
Kaitaia	1298	Kaitaia	93.52
Taihape	1188	Tikapu	93.52
Mangatoki	136	Mangatoki	93.51
Lepperton	49	Lepperton	93.41
Rangitikei	1360	Rangitikei	93.40
Levin	910	Lake	93.40
Shannon	1489	Shannon	93.39
Kiwi	299	Kiwi	93.37
Omata	82	Lily	93.36
Stratford	68	Three Star, Good Luck ..	93.25
Sefton	28	Sefton	93.14
Rangiwahia	750	Quail	93.13
Whangarei	1720	Kauri	93.11
Eltham	31	Eltham	93.11
Featherston	360	Featherston	93.11
Pio Pio	603	Pio Pio	93.09
Hikurangi	303	Hikurangi	93.09
Overland	197	Overland	93.06
Awahuri	664	Red Rose	93.01
Riverdale	106	Trident	92.99

BUTTER-FACTORIES—*continued.*

Name of Company.	Registered Number.	Brand.	Average Grade
			Points.
Oruru-Fairburn	1337	Fairy	92.90
Golden Coast	991	Golden Coast	92.88
Avon	963	Avon	92.88
Moa Farmers	341	Inglewood	92.83
Heretaunga	1230	Heretaunga	92.83
Murchison	1888	Airship	92.81
Hawera	346	Federation	92.80
Tai Tapu	175	Tai Tapu	92.78
Aria	1734	Aria	92.77
Ruawai	66	Ruawai	92.77
Maungaturoto	1407	Maungaturoto	92.74
Wauroa	1345	Wauroa	92.73
Whangaroa	658	Whangaroa	92.72
Cheltenham	6	Pakeha	92.72
Kaitieke	1119	Kaitieke	92.71
Tikorangi	102	Shield	92.69
Waitanguru	1154	Golden Gem	92.64
Canterbury Central	55	Fernleaf	92.64
New Zealand (Ngatea)	291	Anchor, &c	92.62
Wairarua	268	Arrow	92.62
Raetihi	717	Raetihi	92.62
Buller Valley	277	Buller	92.61
Bay of Plenty	1399	Bay of Plenty	92.60
New Zealand (Frankton No. 1)	1510	Anchor, &c	92.59
Canterbury Alpine	792	Pine	92.56
Masterton	1307	Masterton	92.52
Cheddar Valley	611	Cheddar Valley	92.51
Kaikoura	302	K.A.I.	92.50
Caroline	236	Caroline	92.50
Northern Wauroa	1358	Northern Wauroa, &c.	92.49
Waitara	726	Waitara	92.49
Uruti	300	Uruti	92.48
Opotiki	337	Opotiki	92.46
Kaponga	732	Kaponga	92.42
Taieri and Peninsula	54	Taieri and Peninsula	92.38
Kaimata	992	The Oaks	92.37
Meremere	316	Meremere	92.37
North Taranaki	723	Flax	92.34
Rotorua	724	Geyser, &c	92.32
Mount Hutt	284	Mount Hutt	92.31
Taieri and Peninsula	1234	Taieri and Peninsula	92.30
Opunake	884	Opunake	92.29
New Zealand (Waharoa)	293	Anchor, &c	92.16
Patua	73	Patua	92.16
New Zealand (Otorohanga)	185	Anchor, &c	92.14
Konini	1203	Konini	92.07
Tarata	631	Tarata	92.05
Cam	168	Cam	92.05
New Zealand (Waihou)	1458	Anchor, &c	92.04
Golden Bay	146	Sovereign	92.02

CHEESE-FACTORIES WITH AN AVERAGE GRADE OF 91 POINTS AND
OVER FOR YEAR ENDED 31ST MARCH, 1924

Name of Company.	Registered Number.	Brand.	Average Grade.
Pihama	627	Pihama	Points.
Kakaramaea	630	Penguin	92·97
Opouriao	1169	Opouriao	92·88
Te Horo	134	The Allies	92·69
Rimu	1155	Rimu	92·65
Temuka	207	Temuka	92·65
Waianawa	1171	Waianawa	92·58
Little Akaloa	32	Little Akaloa	92·58
Omimi	74	Omimi	92·44
Brydone	1821	Brydone	92·43
Edendale	36	Edendale	92·39
Milford	267	Milford	92·35
Ngairi	25	Triumph	92·31
Tuturau	132	Tuturau	92·29
Bell Block	488	Bell Block	92·38
Mosgiel	161	Mosgiel	92·24
Kaimata	992	The Oaks, The Ash	92·22
Nireaha	335	Nireaha	92·21
Kiritaki	1521	Premier	92·21
Riverbank	985	Riverbank	92·18
Tamaki	58	Big Ben	92·18
United	1296	Whariti	92·15
Pihama	1111	Pihama	92·11
Kairanga	182	Kairanga	92·11
Maharahara	984	Maharahara	92·10
Kaponga	1094	Kaponga	92·10
Stirling	292	Stirling	92·08
Cambridge	125	Fencourt	92·07
Okato	18	Puniho	92·07
Mangatoki	136	Mangatoki	92·02
Alton	1890	Alton	92·00
Bell Block	71	Dove	91·96
Kaupokonui	1099	Auroa	91·96
Wyndham	59	Wyndham	91·96
Staveley	1719	Staveley	91·95
Mangatoki	1086	Mangatoki	91·94
Ballance	1	Ballance	91·93
T. L. Joll	1727	Maori Chief	91·92
Pembroke	234	Pembroke	91·91
Marima	195	Marima	91·91
Tuna	209	Tuna	91·90
Kakepuku	83	Kakepuku	91·89
Wairewa	471	Wairewa	91·86
New Zealand (Rukuhia)	114	Anchor, &c.	91·84
Tariki	1700	Tariki	91·83
Awatuna	1622	Taungatara	91·83
Rapanui	1907	Southern Grove	91·82
Tariki	216	Miro	91·79
Rongokokako	280	Rongo	91·79
Tisbury	701	Tisbury	91·78
Thornbury	1581	Thornbury	91·77
Kai Iwi	1309	Kai Iwi	91·76
Milton	1030	Milton	91·76
Kaupokonui	633	Kaupokonui	91·75
Kuku	905	Ohau	91·75
Boggy Burn	703	Boggy Burn	91·74
Pihama	1112	Pihama	91·68
Opouriao	1813	Ruatoki	91·66

CHEESE-FACTORIES—continued.

Name of Company.	Registered Number.	Brand.	Average Grade.
			Points.
Cam	168	Cam	91.62
Waikouaiti	18	Waikouaiti	91.62
Toa Toa	817	Toa Toa	91.61
Cape Egmont	632	Cape Egmont	91.61
Wright's Bush	206	Wright's Bush	91.61
Hauraki Plains	1900	Hauraki Plains	91.60
Mells	764	Mells	91.60
Cambridge	1239	Cambridge	91.59
Royal Oak	693	Royal Oak	91.59
Riverdale	106	Trident	91.58
Island	72	Island	91.58
Whiterig	798	Whiterig	91.57
Kaponga	1696	Rowan	91.55
Otautau	1610	Otautau	91.55
Taratahi	101	Taratahi	91.52
Okato	85	Okato	91.49
Wellington Municipal	202	Rahui	91.49
T. L. Joll	1723	Maori Chief	91.46
Patua	73	Patua	91.45
Pukerau	480	Pukerau	91.44
Woodlands	1485	Woodlands	91.44
Aparima	188	Aparima	91.40
Awatuna	60	Awatuna	91.38
Okato	57	Leith	91.36
Paretai	271	Paretai	91.36
Frankley Road	201	Frankley Road	91.35
Mangatoki	1087	Mangatoki	91.35
Kohi	923	Kohi	91.35
Kaupokonui	174	Skeet	91.35
Kaitangata	1648	Kaitangata	91.33
Seaward Downs	702	Seaward Downs	91.33
Kaponga	1695	Riverlea	91.32
Cambridge	128	Gracedale	91.30
Mataura	38	Mataura	91.30
New Zealand (Aka Aka)	121	Anchor, &c.	91.24
Momona	1010	Allanton	91.24
Tokoroa	255	Tokoroa	91.22
Makowhai	213	Makowhai	91.22
Mata	258	Vale	91.22
Mells	1148	Mells	91.20
Morton Mains	1604	Morton Mains	91.20
Lochiel	659	Lochiel	91.19
Henley	1627	Henley	91.18
Mangatoki	256	Mangatoki	91.17
Barry's Bay	401	Barry's Bay	91.15
Cambridge	126	Leamington	91.14
New Zealand (East Tamaki)	149	Anchor, &c.	91.11
Bainesse	808	Bainesse	91.11
Awarua	545	Awarua	91.10
Kennington	205	Kennington	91.10
Tamaki	1463	Bell	91.08
Ashburton	81	Ashburton	91.08
Westmere	1621	Westmere	91.05
Oaonui	491	Gem	91.05
Takamatua	33	Takamatua	91.05
Menzies Ferry	623	Menzies Ferry	91.05
Manakau	815	Black Swan	91.04
Whenuakura	1237	Whenuakura	91.01

SEASONAL NOTES.

THE FARM.

CROPPING PLANS.

It is always a good policy to plan field-work well ahead, and if plans for the coming season have not been decided upon no time should now be lost. Owing to their liability to insect and fungoid attacks, cruciferous crops (turnips, rape, &c.) should preferably be given new ground. Mangolds also do well on new ground, but if the land is in good heart they may be grown successfully year after year in the same paddock: if the land is cleaned thoroughly during the growing of the first crop the cost of the subsequent crops will be greatly reduced.

Farmers experiencing difficulty in growing turnips should turn their attention to crops from which ensilage may be made. Oats will grow on almost any soil, and if sown in mixture with a legume (either tares or peas) give a well-balanced highly-palatable crop, which can be used for soiling, hay, or ensilage. If sown fairly thickly—say, $2\frac{1}{2}$ bushels of oats and 1 bushel of tares or $1\frac{1}{2}$ bushels of peas—most annual weeds will be smothered out. These crops must be sown early and manured with 2-3 cwt. of superphosphate or other quick-acting manure. The legumes will improve the soil, and time is available after cutting for giving the paddock a short fallow during the dry weather.

WINTER PLOUGHING.

The midwinter months allow of comparatively little in the way of cultivation except ploughing of land for spring-sown cereals, and roots and fodder crops for spring and early summer sowings.

In Canterbury and North Otago if wheat has not been sown by about the middle of June it is as well to postpone the operation until the beginning of August. Where it is intended to break up grassland for spring sowing this operation, under Canterbury conditions, should be done in the winter. The action of frost has a beneficial effect in pulverizing the soil, and the maximum amount of water can enter and is more readily taken up by the subsoil. The latter may be looked upon as a reservoir which feeds the soil as its moisture is evaporated or used up by growing crops.

DRAINAGE.

At this time of year all open drains should be thoroughly cleaned, and drainage operations generally completed. Nothing retards the early growth of pasture and crops in the spring so much as a wet and cold subsoil. Money spent on manures and lime is more or less wasted where drainage is the controlling factor. Low-lying areas on land which is really not in need of complete drainage often

become inundated during a wet winter, and every observer must have realized what decreases in yield are brought about by this cause. Such patches can often be successfully drained by a single furrow.

PASTURES.

Pastures should be harrowed in July to spread manure before the spring grass begins to come away. Where stock have congregated round gateways, haystacks, or shelter-belts it is well worth while carting off the dry manure to poorer parts of the paddock. Young grass on light land will be benefited by rolling; this operation should not, however, be performed on a frosty morning. Top-dressing of pastures, which was dealt with last month, may be continued.

Clover stands being saved for seed should receive a minimum of cultivation in the first year. In the second year an occasional stroke with the light harrows prior to shutting up in August would in many cases prove beneficial. Super may be applied with benefit before the beginning of August to clover stands being saved for seed.

LIMING.

On damp and naturally sour land—particularly in large areas of Otago and Southland—lime should be applied during July and August, so that its beneficial influence may be felt during the ensuing spring. On the heavy raw types of soil ground burnt lime can be most advantageously used, dressings of 15 cwt. per acre generally sufficing. On the lighter soils carbonate of lime finely crushed, applied at about 30 cwt. per acre, is advised. For general purposes 18 cwt. of carbonate of lime is equivalent in calcium to 10 cwt. of burnt lime. It will therefore be appreciated that where carting has to be carried out over long distances burnt lime should be used if possible. The importance of liming in south Otago and Southland cannot be overstressed, and the present comparative cheapness of lime in those districts should be an incentive to the farmers to top-dress a large acreage this winter.

Pasture top-dressing with lime can with advantage be carried out during July. It will result in better pastures, in that one of the main effects of lime is the encouragement of desirable grasses and clovers, and the suppression of undesirable weeds.

WINTER FEEDING OF STOCK.

Every wise farmer will have a run-off handy to his area under turnips, &c., while a good plan also is to have racks made of coarse wire netting supplied with oat straw or hay. Farm stock, like humans, appreciate a mixed diet. Roots are very low in dry matter content, and the dry fodder not only gives the stock more concentrated food but also provides variety. Care should be taken to remove stock during wet weather from roots being fed off on the heavier lands, in order that the texture of the soil may not be spoiled. Neglect in this direction may mean a ruined field for some years.

Any mangolds still in the ground should be pulled or harrowed out at once, so as to give them time to mature further; if they are

left in the ground much longer the tops will start to shoot. If the better-keeping varieties are carefully pulled, the tops removed, and carefully stacked they will keep well into November and in some cases to Christmas. Mangolds may be fed quite safely to breeding-ewes, providing the ewes are brought on to them gradually. The roots should be carted out from the dumps daily. Up to 15 lb. or 20 lb. per sheep per day will be a suitable amount if fed to supplement dry fodder. For cows also receiving hay about 60 lb. of roots is a suitable ration.

In some districts thousand-headed kale and chou moellier is grown for July-August feeding. Care must be taken not to feed these too liberally to newly calved cows, otherwise there is a danger of red-water. If this class of forage is cut and allowed to wilt for a day or two before feeding there is not much danger.

One or more top-dressed and harrowed paddocks should now be selected and shut up for early calving cows and early lambing ewes. There is nothing better for these animals than a nice clean pasture.

—*Fields Division.*

THE ORCHARD.

PRUNING.

During the next two months pruning should be pushed along with all possible speed. Advantage should be taken of all favourable weather in order to complete this important work before growth commences in the spring. If found necessary, pruning operations can continue up to the end of August or even until early September. The main reason for endeavouring to complete this portion of orchard operations earlier is owing to the fact that there are other phases of work, such as spraying and cultivation, that call for immediate attention during August and September.

Gathering up the prunings and burning them should on no account be neglected, even for a single season. This should be done with as little delay as possible after the pruning is completed. Where young trees are being pruned the operator will find that the gathering up of the prunings will be much facilitated if he lays hold with one hand the piece to be cut off, while using the secateurs to cut with the other. Once this habit is acquired one very soon finds that the prunings as they accumulate in the hand can be laid in a heap under the tree ready to be gathered up. Moreover, one can go still further than this by having around his waist a bag or loose piece of scrim, with the other end swung over the neck, in which can be placed the prunings from a number of trees. These can be emptied in heaps at convenient places, which will still further facilitate the gathering-up. Prunings can be easily burned once a small fire has been commenced with some dry material. The ashes should be saved either for using in the orchard or, at a later period, in the vegetable garden. They should be kept dry until required, as if exposed to the rain they quickly lose their manurial value.

One of the sources of disease is the heap of unburnt prunings often left about from year to year. Scale insects, red mite, woolly aphis, and fungoid diseases are almost invariably found on prunings. Another point necessary to stress is the complete eradication (root and branch) of any trees that have died or been cut down owing to silver-blight infection. I have very often seen the stumps of trees remaining in the orchard after the tops have been cut away. The *Stereum purpureum* organism grows freely on limbs or stumps of this kind (see article by G. H. Cunningham, in *Journal* for May, 1922). From these spores are given off, which may be the cause of a good deal of infection in the orchard and possibly throughout the district.

SPRAYING, ETC.

On some varieties of peaches and nectarines leaf-curl is somewhat difficult to control, and such varieties as Wiggins, Carmen, Paragon, Elberta, and Early Rivers should receive a spraying of pure bluestone (1 lb. to 12 gallons of water) some time early in July, followed later with bordeaux. Further instructions will be given next month.

If San Jose scale is at all in evidence all stone-fruit should be sprayed with lime-sulphur (1 in 12) or red oil (1 in 15).

Much useful work can be accomplished at this season in the control of woolly aphis on apple-trees. When this pest makes its appearance on trees for the first time much can be done to prevent it spreading if the affected parts are painted with red oil diluted with water, using 1 part of oil and 1 part of water. A fairly stiff paint-brush is the best to use, and each infected part should be carefully painted. It is surprising how quickly one can get over a large number of trees in this way, and the colonies which usually winter over on these knotted and distorted places will be entirely destroyed. The best time to do this work is soon after the leaves have fallen and before the application of any spray mixture.

OTHER WORK.

As mentioned last month, planting should only be proceeded with if the land is of a dry nature, and unless good conditions prevail it should be postponed until August.

Where cover-crops have made sufficient growth attention should be given to ploughing them under, but only provided the land is not too wet. It is often more harmful to plough when the land is in a sodden condition than to postpone this work until a later date.

Full advantage should be taken of any broken weather during the winter months of cleaning up and repairing orchard harness, tools, and implements. The spray pump and engine should be given a thorough overhaul, as much valuable time may otherwise be lost during the busy spraying season. Failure to control some of the diseases may also result, and in consequence the material receives the blame.

SHELTER.

In most parts of New Zealand fruit cannot be grown without shelter, and every fruitgrower should make adequate provision in this direction. In certain localities the high winds of last season proved

the necessity for this. Two of the most suitable trees for this purpose are *Pinus insignis* and Lombardy poplar. They both grow very freely and make ideal shelter, but the poplar is of little value unless the land is rich. On the poorer classes of soil *Pinus insignis* has proved to be one of the best. If not already planted, shelter-trees should be placed out as soon as weather conditions are suitable.

—*L. Paynter, Orchard Instructor, Christchurch.*

CITRUS-CULTURE.

This month usually offers a welcome respite to growers in that there is little other work which needs attention than the harvesting of such fruits as may mature from time to time. However, opportunity is afforded for attention to shelter-belts, the trimming of hedges, and any necessary repairs to glass-houses, sheds, implements, &c. Stocks of spraying materials, manures, and other accessories should now be replenished, and spraying outfits overhauled and any renewals made where necessary. Every endeavour should be made to complete the sites for the extension of any citrus areas.

FIREBLIGHT.

It is still necessary to remind orchardists that a sharp lookout should be kept on all pip-fruit trees at this period, with a view of locating any fireblight cankers in areas where the disease is known to have been present. Upon identification the cankers should be entirely removed, as instructed in previous notes. It is quite possible that fireblight hold-over cankers may be present in any pip-fruit orchard, and a thorough inspection of all trees should be made for all such at the earliest opportunity or during pruning-time.

—*J. W. Collard, Orchard Instructor, Auckland.*

POULTRY-KEEPING.

THE BREEDING-PENS.

A MATTER for first consideration now is the mating-up of the breeding-pens. This is one of the most important phases in the poultryman's year, and a time when his judgment is put to a severe test. Profitable production implies profitable stock, and the securing of this rests chiefly on the class of stock mated. Many poultry-keepers consider that the incubating and brooding stages are of chief importance, but these are only necessary links in the chain of management. The quality of the parents is the chief consideration in successful poultry-keeping. The keen poultryman will carefully study his breeding operations, and will be guided by the sound principles upon which the successful breeding of all stock rest. The ABC of this is that like produces like, and that no stock can be too good to place in the breeding-pen.

In recent issues of the *Journal* advice has been given regarding the type of bird most desirable for the breeding-pen, and too much

importance cannot be attached to this. It should, however, be clearly understood that the most productive hen is not always the best breeder. It is never a wise course to place in the breeding-pen a freak type of bird, however good a layer. For the advancement of a strain it is now realized that it is only the type which has been bred true to a given ideal from generation to generation which has the power to transmit desirable characters. Not only should the breeder be a proved good layer, but it should also possess trueness of breed-type and, above all, maximum points indicative of strong constitutional vigour, such as tight feathering, clean face, prominent eyes, well-developed crop, and an active business-like appearance. Another important qualification in the breeding-hen is that it be a layer of good-sized, marketable eggs. Many breeders are pinning their faith to export trade as a means of unloading the summer surplus, but they will find the critical oversea markets will not pay full rates for undersized eggs. The existing problem of the small egg can only be solved by breeders taking greater care in the selection of their breeding-stock, as well as the eggs intended for incubation purposes.

The male bird has also an important bearing on this matter—he is more than half the flock. He should be the son of a healthy mother with a pedigree of egg-laying performance behind her and a producer of first-grade eggs.

As to size, whether in male or female, one should never breed from diminutive specimens of their breed. The small ones will come soon enough even where good-bodied birds are mated. If a desirable size of stock is to be maintained, all breeding-stock should conform to the weight clauses as contained in the Utility-poultry Standards for the respective breeds. Copies of the Standards are obtainable from the Department at a cost of 3s. each, postage free.

PRODUCTION OF AUTUMN AND WINTER EGGS

Autumn-produced eggs again reached a high-price level this year, thus indicating that the majority of poultry-keepers have not yet learnt how to produce this what might be termed "out-of-season" luxury. In Wellington during March and April the price gradually rose till eggs were being retailed at about 3s. 8d. per dozen. As a result those poultry-keepers who hatched out a fair number of chickens in July and who managed their plants to the best advantage reaped a good reward. In addition to having a good number of pullets producing at that time they took care that a large proportion of the adult stock were in a laying condition. This condition of the flock was attained by reason of the fact that none but the late moulters—in other words, those birds which gave promise of being long-season layers—were retained on the plant. The early moulters and poor layers had been previously got rid of. Under this method of management, together with the high ruling price for eggs, a good margin of profit over and above the expenses of running the plant was secured.

This is a striking contrast to the returns secured on the great majority of plants at this period of the year, where the eggs gathered

do not even pay for the food consumed. It may be argued that the bulk of July-hatched pullets will moult with the adult stock, and that there will be a loss of winter eggs. It is quite possible that they will, but on a well-managed plant there should be later-hatched pullets specially bred to lay during the cold months of the year. In any case the early-hatched birds will not all moult and cease to lay at exactly the same time. With such birds it will generally be found that eggs, in more or less degree, will be obtained right through the dear season. The reason for this is that while some birds will moult early others will continue to lay, so that when the latter are moulting the former will have renewed their feathers and be ready to resume laying. Then, again, owing to the fact of such birds moulting during the late autumn or early winter they can usually be depended upon to lay well into the autumn during the following year, when the price of eggs is on the up-grade. Generally speaking, the poultry-keeper's most lean period of the year is from, say, the middle of March to the end of May. In most cases the adult stock are then taking their period of rest, while owing to late-hatched birds or through indifferent management the pullets fail to produce when expected. This means that there is much money going out and little coming in. If the maximum results are to be secured sufficient eggs should be collected to at least balance expenses. Just as the successful market-gardener aims at a rotation of crops and has something to sell each month of the year, so must the poultry-keeper be in a similar position if his business is to be really profitable.

After all, there is no great secret in securing a fair supply of autumn or even winter eggs. The right class of stock is available to produce them as well as the knowledge to manage the plant on paying lines. It is thus merely a matter of securing high-tested stock, and knowing how to apply the available knowledge in regard to their management. The latter is the great essential—in other words, it is the human element that counts most. Theory is all very well in its way, but this must go hand in hand with practical experience. The poultryman who secures eggs in the dear season and generally makes a success of his business is usually termed lucky by those who fail. There is no luck about it, for it is nothing more than common-sense management combined with strict attention to details. I have recently received many complaints from people who have tried to secure autumn and winter eggs but have failed in their objective. In most cases the cause is put down to the same old trouble—bad luck—and so it goes on from year to year. There are some people, however, who start on a sound financial footing, understanding something of poultry-keeping, who consistently endeavour to improve their methods and conduct the business in a careful and methodical manner. Somehow they never have bad luck. True, at times they make mistakes, but these are seldom of any moment. They succeed in the things that really matter, and thereby make poultry-keeping the profitable work it is to those who thoroughly understand it and treat it as a serious proposition to be mastered and conducted on the same strict business principles as any other commercial undertaking.

With the many complaints reaching me in regard to pullets failing to lay when they were expected to little mention is made of the conditions surrounding the stock to enable me to arrive at a probable explanation of the difficulty. Rather than content themselves that bad luck alone has been responsible for their disappointments I would advise these and others who have had a similar experience to ask themselves the following questions: When were the pullets hatched—too early or too late? Were they bred from tested winter-laying stock? Were they properly reared? Was the class of food altered too often, or was inferior food purchased because it was cheap? Was old wheat suddenly changed to new wheat—a common cause of poultry moulting? Did the birds receive a regular supply of animal food, so imperative for the production of winter eggs? Were green food and grit always available? Did the birds contract colds and spread them through the flock by reason of a draughty house and failure to find and remove the cause; or was it due to an exposed position and failure to provide shelter? Were the birds and houses infested with vermin? Had the runs been allowed to become poultry-sick, and were the birds infested with intestinal parasites from this cause, or was there any attempt made to rear the pullets on clean ground, so essential for their welfare? Even those questions do not cover the whole field which calls for investigation to account for much of the so-called bad luck. It should never be forgotten that if the birds are well housed, well fed, and properly managed, and yet do not lay well it may be taken for granted that they are a poor laying strain. The best remedy is to get entirely new blood of a strain noted for egg-laying power.

One little point which may be mentioned in regard to securing early chickens is that in June or July it is seldom that second-year birds are laying, and in order to secure early chickens the poultry-keeper is forced to use pullet eggs for incubation. Of course, the principle of breeding from pullets for the maintenance of a heavy-laying flock, or, in other words, as foundation stock, is on no account recommended; but in the case of breeding pullets especially for the production of autumn eggs an exception must be made. In any case, the pullets bred for this purpose need not necessarily be used as breeding specimens. The use of pullets is not so much objected to, provided they have been bred from an adult hen and commenced to lay early in the year without being forced, and have moulted in the usual way about April or May. Where pullets are to be bred from it is desirable that they be mated with a second-year male. The great danger lies in using pullets in the breeding-pens generation after generation, as the chances are that the stock as well as the eggs they lay will decline in size. Especially is this the case when the pullets have been mated with cockerels bred in the same way.

There is every reason to believe that autumn and winter eggs will be as dear next year as during the present one. Poultry-keepers should therefore look well ahead and prepare now to secure them, remembering at all times that a dozen eggs produced in the autumn and winter months are worth more than two dozen of the spring and summer product.

• —F. C. Brown, *Chief Poultry Instructor.*

THE APIARY.

WINTER WORK.

Spare supers that were left on the hives should now be removed, where it can be done without unduly disturbing the cluster, and the bees confined to the brood-chamber. In the northern parts of the Dominion breeding will start in colonies of normal strength at the latter end of July, and every effort should be made to make the bees snug, so as to promote breeding. Where the bees have taken to the supers entirely the bottom storey is the one to be removed.

During the dormant season mice are likely to make themselves troublesome in the apiary. They attack the stores, and otherwise destroy the combs. Many colonies are by this means reduced to the verge of starvation by the spring. It is the work of only a few minutes to examine the hives, and where gable roofs are adopted the mice-nests will usually be found on top of the mats. To obviate this trouble the entrance should be contracted.

A periodical examination should be made of all extracting combs stored in the honey-house, for the purpose of seeing that they are not attacked by moths. Where the combs have been attacked they should be fumigated. To fumigate place the combs in supers piled one above the other, and put a saucer full of carbon bisulphide on the top. The fumes, being heavier than air, will sink slowly to the bottom, destroying all moths and eggs with which they come in contact. Care should be taken not to inhale any of the fumes, as they are poisonous. The gas being highly inflammable, it should not be brought into contact with a naked light.

MOVING BEES.

The present is the one and only season during which beekeepers should attempt any wholesale shifting of their bees. The bees will be in as nearly dormant a condition as it is possible to find them in our mild climate, and they should be numerically weaker than at any other time of the year. The moving of bees either long or short distances has in each case peculiar difficulties to be overcome. In the former case there is the question of ventilation to be thoroughly considered, and also the matter of making the inside of the hive as immovable as possible. The vibration set up by any mode of transport tends to disturb the cluster, thereby exciting the bees and thus raising the temperature of the hive. When this takes place the bees are in danger of suffocation and the brood of being scalded. The use of wire screens will to a large extent prevent the occurrence of these troubles. Where possible all heavy combs should be removed from the hives, leaving only sufficient honey to keep the bees from starvation during their journey. The vacant spaces should be filled with empty combs, and the frames made as secure as possible by inserting wedges between the tops of the end frames and the walls of the hives. This should prevent the frames from rocking during transit. The bottom board should be secured to the hive-body by means of crate staples, using about six to each hive and driving one end of the

staple into the hive-body and the other into the bottom board. The wire screens—made by using narrow laths nailed together to form a frame of the same dimensions as the top of the hive-body and covered with wire-cloth—should be securely fastened to the top of the hive-body, and more wire-cloth tacked over the entrance to the hive. This last operation should be carried out at night when all the bees are indoors.

The hives should now be quite ready for a long journey. The roofs will, of course, not be needed. In placing the hives in a cart or truck they should be arranged so that ventilation through the wire screens will not be interfered with. If stacked exactly one on top of another the bottom ones will be prevented from obtaining the requisite amount of air. Wooden battens should be placed between each two tiers. Motor transport is, of course, the ideal method of dealing with bees, and where possible the beekeeper should adopt this means.

In moving bees a short distance the difficulty is of quite another nature. Sufficient ventilation is easily obtained by means of wire-cloth tacked over the entrance, and with the bottom boards and covers firmly secured to the hive-body by means of staples the hives should carry without any trouble. Unless, however, the beekeeper chooses his time well he is apt to lose many of his field bees when moving the hives a short distance. The field bees know every landmark within a fair distance of their hives, and in the summer their knowledge must extend over several miles of country. With the approach of shorter days their flight becomes correspondingly shorter, until in the depth of winter it resolves itself into a mere search for exercises. Consequently when a spell of bad weather arrives, and the bees are confined to the hives for days at a time, their familiarity with their surroundings must lessen. Therefore if the beekeeper wants to move the bees a short distance with a minimum of loss he should choose a time when there is a prospect of several wet cold days arriving. By the time the bees are able to take a flight again they will have lost all interest in the old landmarks and be just as ready to adopt the new site as the old. By removing bees a short distance during a spell of fine weather innumerable field bees will be lost through their tendency to return to the old site on leaving the hive. It may be mentioned that a slanting board, if placed in front of the entrance of the hive, will make the bees take more notice of the change of their surroundings than they otherwise would.

PLANS FOR NEXT SEASON.

During the off-season is the best time to make plans for the following season. The beekeeper should decide what increase he desires to make, and should prepare accordingly. Making up hives and frames is exasperating work if left till the bees are in urgent need of room, and it should be finished long before the actual time for increasing one's stock arrives. The beekeeper should also face the question of providing himself with stocks of foundation, and make arrangements for the treatment of his surplus wax by some neighbouring maker of foundation. He should also decide on which market to place his crop, and lay his plans accordingly. It is advisable, too, that he consider the theoretical side of his occupation, and study, while

the bees are in a dormant condition, the best methods of improving his stocks. Neither weather conditions, locality, nor any other factor will influence the honey-crop so much as strong colonies of bees, and the apiarist should endeavour, while he has the time, to ensure that these shall be in existence during the coming summer.

—*E. A. Earp, Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

NEW season's operations in the vegetable garden commence with the month of July, and the grower who desires to be successful will take the opportunities as soon as they arrive. As soon as the land can be got into condition plant early potatoes, artichokes, shallots, cabbage, and cauliflower plants, herbs, garlic, and autumn-sown onions. Sow peas, main-crop onions, and a small quantity of carrots, lettuce, radish, and parsley. Autumn-sown peas, and spring cabbage and lettuce planted out towards the end of March should be cleaned up, and, as soon as growth commences, receive a little manure to push them along.

This matter of manuring is most important and yet most difficult to write about, as the circumstances differ in every case. It is a point on which every grower must take a special study. A useful dressing just before sowing is $1\frac{1}{2}$ oz. each of superphosphate and bone-dust, also $\frac{3}{4}$ oz. of sulphate of potash, per square yard. To liven up young plants inclined to lag $\frac{1}{2}$ oz. to $\frac{3}{4}$ oz. of nitrate of soda or sulphate of ammonia per square yard is useful; it can be applied at intervals of a fortnight or so. It is also useful for keeping plants in bearing. The gardener may remember that 1 oz. to the square yard equals $2\frac{1}{2}$ cwt. to the acre.

At the present time the asparagus beds should be cleaned up and an application of wood-ashes applied, followed by a good dressing of half-rotted manure. If this is not available apply 4 oz. of blood-and-bone and 1 oz. sulphate of potash per square yard.

When the ground is finally prepared for onion-seed it is most desirable to make an application of soot—sufficient to colour the ground; it has qualities specially helpful to this crop.

SMALL-FRUITS.

The planting of small-fruits—raspberries, strawberries, currants, and gooseberries—should be completed now as soon as the weather permits. Each of the shrubby kinds will need careful pruning as soon as planted. Raspberry-canes should be cut down to within 6 in. of the ground. Black currants will require the main growths to be cut back hard to induce vigorous growth. Red currants will need a little more discriminate cutting, so that suitable terminal buds are selected to fork the branches and form the desirable cup-shaped arrangement of leaders. Gooseberries will require a somewhat similar treatment.

Established plants also will require careful pruning and generous manuring if good crops are to be maintained. Heavily thin the twigs on

gooseberry-bushes, cutting back old wood and weak wood to within a bud or two of the base, and leaving only strong new shoots evenly distributed over the branches which form the framework of the plant. Black currants too often make poor growth through lack of pruning and manures. As the crop is borne chiefly on the young wood, the older growth should be cut well back to induce a strong growth of the fruit-bearing wood. Red and white currants, on the other hand, require gentler treatment once the bushes are set, as the fruit is borne on laterals and spurs, which will require a little thinning and shortening occasionally to keep them sufficiently vigorous for cropping. Raspberries will also require their usual winter pruning.

Contrary to the general practice, all such small fruits should now receive a thorough dressing of a well-made bordeaux mixture of winter strength. If this is followed by a good dressing of manure—three parts superphosphate and one part each of sulphate of ammonia and sulphate of potash—say, at the rate of 2 oz. to the square yard, good though shallow cultivation, satisfactory results may be expected.

FLOWERS AND LAWNS.

Flower borders and shrubberies may now be cleaned up. It is usual after clearing away all dry sticks and litter to skim-dig them. This is work requiring great care, and should be done only by some one who knows the details of the planting. This is an excellent opportunity of working in such manures as may be required—organic manures or lime, bonedust or superphosphate. In a state of nature herbaceous plants in any quantity do not remain in one place, but gradually creep to new soil. In the garden this has to be met by artificial feeding and replanting every few years, if best results are to be obtained.

Excellent crops of that pleasing winter-flowering plant the anemone may be obtained from seed planted now on a piece of well-prepared light land in a sunny position. They will flower next winter.

The work of trimming hedges and pruning trees and shrubs should be completed. It is best to defer rose-pruning till the danger of hard frosts is over.

Lawns in a mossy, poor condition will be much improved if they are now well raked up and some seed sown before top-dressing them with $\frac{1}{4}$ in. to $\frac{1}{2}$ in. of good fresh loam to which has been added a fourth part of powdered lime.

—W. C. Hyde, *Horticulturist*.

Goats for controlling Blackberry.—A correspondent writes asking whether any *Journal* readers can inform him where in or near Auckland goats can be procured with the object of controlling blackberry. Any information addressed care of the Editor will be forwarded.

Feeding off Roots.—Where roots are being fed off, the breaks should not be made too large. An area to last the stock for a week or ten days is quite large enough.

Shelter for Farm Stock.—Hedges and tree shelter-belts are a profitable investment. This is the planting-season.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

COWS SLIPPING THEIR CALVES.

"TUSSOCK," Reporoa :—

Several of our cows have slipped their calves while grazing on young grass and soft turnips. They only had from one and a half to two hours on the green feed each morning, and were then turned on to old pasture. Would the turnip-tops be likely to cause trouble under the circumstances? The cows were from three to four months off calving.

The Live-stock Division :—

While it is possible for the feed you describe to produce bloating, which condition occasionally causes a cow to slip her calf, it would be safer to take the precautions necessary for dealing with contagious abortion. The aborted cows should be immediately isolated in a paddock by themselves for a period of from four to six weeks. They should be washed out daily for the first week, with a solution made by dissolving one teaspoonful of permanganate of potash in a gallon of water, and later every second or third day, until all discharge has ceased. Aborted cows should not be put to the bull for at least two months.

BLUESTONE TREATMENT FOR FOOT-ROT IN SHEEP.

"ROMNEY," Takaka :—

Please inform me at what strength to use bluestone when dealing with foot-rot in sheep; what amount of bluestone one should dissolve in one gallon of water; and what time the sheep should be allowed to stand in the trough.

The Live-stock Division :—

Where a large number of sheep are affected the foot-bath method of treatment is recommended. For mild cases 3 oz. of bluestone to the gallon of water should be sufficient. More serious affections can be treated with a strength up to $\frac{1}{2}$ lb. to the gallon. Before treatment care should be taken that all loose and diseased parts are removed from the animals' feet.

REMOVING PEAR-TREES.

C. I. BARTON, Raetihi :—

I have a couple of pear-trees about fifteen years old and in full bearing, which I wish to move to a new position about half a mile distant. Kindly tell me if this can be done with safety to the trees, and how I should go about it.

The Horticulture Division :—

Under normal conditions there should be nothing to prevent the successful removal of the pear-trees as long as labour and power are available. Commence by pruning the trees hard, thinning laterals and leaders where possible, and shortening back to wood-buds those that are left. Next dig a trench round the tree at a distance of a yard or so from its base and sufficiently deep to get below the main roots, when the tree should be undermined and all downward roots cut. Then by steadily rocking the tree and filling the hole it can be raised to the ground level, when, if the tree is laid over on its side, it can be rolled on to a sledge and removed. If left at any time during removal the roots should be covered with damp sacks; in fact, during transit it is best to have the roots lashed up in damp sacking. A hole of ample size should be prepared for reception of the tree, carefully gauging its depth. The tree may then be laid over on its side and carefully rolled in, and the sacks removed. Fill in the hole and tamp the surrounding space. Before completing the filling it is best to give a good soaking with water.

RATSTAIL IN PASTURES.

"SUBSCRIBER," Opotiki :—

Kindly inform me whether it is possible to eradicate ratstail-grass by any other means than by ploughing.

The Fields Division :—

In some districts, notably parts of North Auckland, ratstail where it is predominant in a pasture is successfully burnt. To do this it is necessary to have plenty of growth, even if it means leaving the paddock unstocked all winter. The grass is fired in September, and then sown with a mixture of clovers, Lotus major, and grasses, together with 3 cwt. or 4 cwt of basic super or super and slag. The idea is to get the new grass away well ahead of the ratstail. The area should be heavily stocked the following season. Where the ratstail is scattered, cutting early for hay (before seeding) and top-dressing immediately afterwards will tend to check it. Otherwise there is nothing for it but ploughing and summer cultivation. We presume you are on the flat, and the Opotiki flats are far too good for ratstail. Crops of maize or mangolds well intercultivated would help you.

LAW AS TO RABBIT-PROOFING A BOUNDARY-FENCE.

M. B. S. YEOMANS, Karioi :—

Kindly advise me if it is legally compulsory to pay half the expense of rabbit-proofing a boundary-fence.

The Live-stock Division :—

The Fencing Act, 1908, has been amended by the Fencing Amendment Act, 1922, and the law now provides that where a dispute as to liability to contribute towards the erection of a rabbit-proof fence or the conversion of a non-rabbit-proof fence into a rabbit-proof fence has been taken before the Magistrate's Court to determine, the Magistrate, when hearing the case, shall take into consideration the condition of the rabbit pest in the district and the possibility of the land occupied by the person giving the notice becoming infested with rabbits from the adjoining land. If the Magistrate should decide that the receiver of the notice be not required to contribute the half-cost of the fence, the giver of the notice may convert the fence at his own cost, and may at any time remove the wire netting from the fence and deal with it as his own property. After the wire netting has been erected on a fence to convert it into a rabbit-proof fence, the adjoining owner (the receiver of the notice), even though he has not been called upon to pay half-cost of the conversion of the fence, shall nevertheless be liable to bear the half-cost of repairing such fence as a rabbit-proof fence until the wire netting is removed.

LINSEED FOR HORSES.

"SUBSCRIBER," Ashburton :—

Will you kindly advise me as to the value of linseed for keeping horses in health; also proper method of using it, and amount that may be used?

The Live-stock Division :—

Linseed is a highly nitrogenous and fatty food, but its carbohydrate matter is small. It is therefore an unbalanced ration, and should be fed with other mixtures such as oats, bran, and chaff. Healthy horses do not require it, but as a diet for sick animals it is very valuable on account of its nutritious properties. For horses out of condition it is a useful addition to the diet if used in small quantities, certainly not exceeding 1 lb. per horse per day. The best method of preparing linseed is by prolonged boiling, by which a jelly-like mass is obtained.

NOTES.—An unsigned letter, making inquiries regarding lucerne, has been received from a correspondent at Kumeu. As a visit to the farm is desirable in this case before advising, he should communicate with the Instructor in Agriculture, Department of Agriculture, Auckland. "Learner," Murchison, should forward his name to the Editor.

WEATHER RECORDS: MAY, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

RAINFALL records for May show great excess, especially in the northern and east-coast districts of the North Island. The South Island returns present less diversity, although the total is considerably below the average for the month in South Canterbury, while it is in excess in North Canterbury and in Otago--being 34 per cent. above at Dunedin and 28 per cent. at Invercargill.

Two cyclonic disturbances passed in the North on the 3rd and 17th respectively. The centre of the former travelled northward of the Bay of Plenty, apparently from the direction of the Kermadec Islands, while the latter, coming from the north-west, traversed the northern districts. While the centre was in the vicinity of Awanui, the officer in charge of the wireless station observed and corrected the reading of the standard barometer, which showed a minimum of 28.50 in. It had fallen from 30.43 in. on the 13th, and recovered to 30.05 in. on the 19th. Little change in atmospheric pressure followed over the Dominion until the end of the month, but on the 25th a remarkable storm of heavy rain and fierce easterly gales visited the northern and east-coast districts of the North Island. Although the barometer was high and did not move more than $\frac{1}{8}$ in. during the storm, it is evident that it was the edge of a cyclonic area operating northward of the Dominion, and a remarkable oscillation of pressure was reported from the Chatham Islands, where barometric pressure reached 30.69 in. on the 26th. This occurrence is one of the most noticeable meteorological events recorded in this country for a long time. Three westerly disturbances of moderate intensity passed in the South, culminating on the 1st, 10th, and 31st.

Temperatures were mild, and the skies more cloudy than usual, but the local differences make further brief generalization impossible.

—D. C. Bates, Director.

RAINFALL FOR MAY, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitia	20.68	21	5.80	5.06
Russell	9.74	17	2.48	3.53
Whangarei	14.41	17	4.75	6.59
Auckland	10.64	22	3.60	4.41
Hamilton	8.34	25	2.21	4.41
Kawhia	7.96	23	1.72	4.77
New Plymouth	6.91	23	1.45	6.16
Inglewood	10.23	23	1.83	9.82
Whangamomona	5.92	20	1.16	6.59
Tairua, Thames	14.94	16	3.00	6.11
Tauranga	7.08	20	1.95	4.88
Maraehako Station, Opotiki	11.42	15	4.40	4.82
Gisborne	13.58	18	2.43	5.50
Taupo	6.62	16	1.76	3.60
Napier	4.80	17	1.92	4.14
Maraekakaho Station, Hastings	5.12	19	1.40	3.52
Taihape	3.36	23	1.12	3.75
Masterton	4.23	18	0.66	3.91
Patea	6.15	19	1.10	3.91
Wanganui	2.96	9	0.66	3.40
Foxton	1.98	9	0.56	2.32
Wellington	3.65	15	1.23	4.73

RAINFALL FOR MAY, 1924—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average May Rainfall.
<i>South Island.</i>				
	Inches.		Inches.	Inches.
Westport	7.06	21	0.90	6.58
Greymouth	9.51	20	1.10	8.39
Hokitika	9.38	20	1.26	9.79
Arthur's Pass ..	6.33	11	1.78	10.93
Okuru, Westland ..	11.30	11	2.00	11.00
Collingwood	10.90	18	3.02	10.18
Nelson	3.13	14	0.90	3.13
Spring Creek, Blenheim ..	2.07	9	0.85	2.49
Tophouse	7.50	15	2.23	5.46
Hanmer Springs	2.40	17	0.72	3.52
Highfield, Wairau ..	2.48	11	0.70	2.76
Gore Bay	4.14	14	1.67	3.43
Christchurch	4.79	19	1.09	2.56
Timaru	1.72	18	0.72	1.27
Lambrook Station, Fairlie ..	0.94	8	0.26	1.28
Benmore Station, Oamarua ..	0.91	13	0.22	1.75
Oamaru .. ..	..	..	..	1.58
Queenstown	1.31	11	0.51	2.71
Clyde	0.69	8	0.20	0.97
Dunedin	4.29	18	0.60	3.20
Gore	3.25	16	0.82	2.84
Invercargill	5.84	20	1.26	4.55

INTRODUCTION OF BEES, HONEY, AND APPLIANCES.

THE regulations governing the introduction of bees, honey, and related appliances into New Zealand, under the Apiaries Amendment Act, 1913, gazetted on 7th October, 1920, have been revoked and replaced by the following:—

1. In these regulations "appliance" means any hive, frame, comb-foundation, or other thing used in connection with the keeping of bees and the harvesting of their products.

2. The introduction of bees into New Zealand is prohibited, save with the precedent consent of the Minister of Agriculture

3. Each application for authority to import bees must be made in writing, and must state the name and address of the breeder, and the location of the apiary from which it is proposed to secure such bees.

4. No appliance which has been used in connection with bees shall be introduced into New Zealand: Provided that in connection with bees imported with the consent of the Minister of Agriculture there may be introduced such used appliances as are necessary to serve as containers for such bees

The new regulations were gazetted and came into force on 5th June current.

PRICE OF STRYCHNINE AND PHOSPHORUS.

OWING to a fall in wholesale values the Department has been able to reduce the price of those materials retailed by it for rabbit-destruction, as follows: Strychnine, reduced from 6s. to 4s. 6d. per ounce (including container and postage); phosphorus, reduced from 4s. 6d. to 3s. 6d. per pound. The new prices date as from 16th May in the case of strychnine, and from 1st June for phosphorus.

REVIEW.

"THE CULTIVATION OF NEW ZEALAND PLANTS."*

IN this little book Dr. L. Cockayne appeals to the highest and purest sentiment—the love of nature. It has been aptly said that in order to grow plants one must love them. The distinguished author is evidently an excellent gardener, for his love of plants stands out in bold relief on every printed page. Within the compass of 139 pages he has condensed the description of some eight hundred New Zealand species which may be grown in gardens for study and delight. This has been accomplished by the adoption in the technical parts of a truncated wording and terse elliptical phrasing easy to follow, the volume being so compact that it slips into the pocket as easily as half a dozen letters for the post. The claims of New Zealand plants to a place in every garden are urged, and the neglect which is so frequently their portion in their native country is lamented. Throughout the author strikes a high patriotic note and demands that New Zealanders shall take more interest in their own unique plants. "They had their origin in this land of ours; it is they which have given the peculiar stamp to its scenery. And of what high quality are they! Is there any tree in the world quite the equal of the lordly kauri? What other flowers surpass those of the kowhai, the pohutakawa, or the white clematis?"

Sections of the book deal with the history of the cultivation of New Zealand plants, how to procure them, and how to grow them successfully; different chapters are devoted to trees, shrubs, and herbs; a whole one is given to that fascinating group the veronicas, a specially remarkable feature of our flora; one to the culture of ferns in the open garden; one to plants for decorating the home; another to school-grounds and children's gardens; and, finally, one to town gardening. At the end is an appendix showing the different purposes to which New Zealand plants may be put, arranged in classes according to the treatment necessary to ensure success in growing them. A good index completes the volume, and there are a number of photographic illustrations. In regard to the printing, by a happy use of capitals and italics the scientific names are easily picked out, and there can be no doubt as to which species is being referred to. The book is an intensely original one in conception and execution. "Excellence consists of trifles, but itself is no trifle"; and in this little book one can detect the influence of the controlling mind accustomed to marshal facts in orderly arrangement and to supervise their presentment to the smallest detail.

It is to be hoped that Dr. Cockayne's enthusiasm will not be in vain, and that the cultivation of New Zealand plants will be greatly stimulated by this publication. With regard to the overseas demand for New Zealand plants, it may be pointed out that New Zealand nurserymen who elect to cater for this market should take pains to supply plants true to name and properly packed. Catalogues published with the botanical names frequently misspelt are not calculated to inspire the possible purchaser with confidence in the nurseryman's knowledge of his business or his capacity to supply the plants asked for.

The reviewer would draw attention to the great need there is for the publication of a cheap and portable book of illustrations to the New Zealand flora, similar to that issued as an accompanying volume to Hooker and Benthams' "Handbook of the British Flora," a small volume which contains 1,315 accurate figures of different species. Mr. Esmond Atkinson's clever drawings show what might be done in this way in New Zealand.

The book is obviously written for the general gardener. In future editions it would perhaps be desirable to somewhat enlarge the scope of the work, introducing chapters dealing with New Zealand plants suitable for special kinds of gardening, such as bog, water, and rock gardens, and the growing of the handsome epiphytes or perching-plants. A little might be said of New Zealand indigenous vegetables and fruits. *Tetragonia trigyna* and *T. expansa* are useful as spinach, the latter being used the world over, and poroporo-pudding is reputed to be delectable. It may also be suggested that the author should add a chapter on New Zealand scented plants, placing at the top that peerless *Olearia fragrantissima*, whose odour is sweetest of any.

* "The Cultivation of New Zealand Plants," by L. Cockayne, Ph.D., F.L.S., F.N.Z. Inst., F.R.S. New Zealand Practical Handbooks Series. Whitcombe and Tombs (Limited), 1924. Price 4s. 6d.



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WORK OF THE SIX-HORSE TEAM AND COST OF CROP-PRODUCTION IN CANTERBURY.

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IN the last December issue of the *Journal* the annual cost of keeping a six-horse team in Canterbury was fully discussed. It is the purpose of the present article to deal with the work done by such a team in the same province, and to make suggestions considered likely to reduce the cost of crop-production, mainly by a more even distribution of team work throughout the year.

In making this inquiry the investigator set out with the following definite questions in view: (1) Cost of upkeep of team; (2) area of all tillage operations performed in eight hours; (3) total area cultivated annually; (4) area under different crops; (5) period at which tillage operations are performed on different crops. Questions (1) and (2) were treated in the previous article, but before discussing the remainder a few remarks relative to (1) and (2) will not be out of place, as they have a direct bearing on any discussion pertaining to the six-horse team.

It was found that the "spread" or variation in twenty-seven estimates of cost of upkeep ranged from £762 to £446, giving an average cost of £548 5s. 8d. (Fig. 1). The largest number of estimates were below the average, suggesting that the actual cost is below £548 rather than above. Obviously there must be good reasons for this variation,

for, although records available were comparatively few and far between, the farmers from whom data were obtained are of a high standard, and reasonable reliance can be placed on their estimates. It appears, then, that the annual cost of the team, and the cost of crop-production generally, are influenced mainly by the following factors: (1) Soil

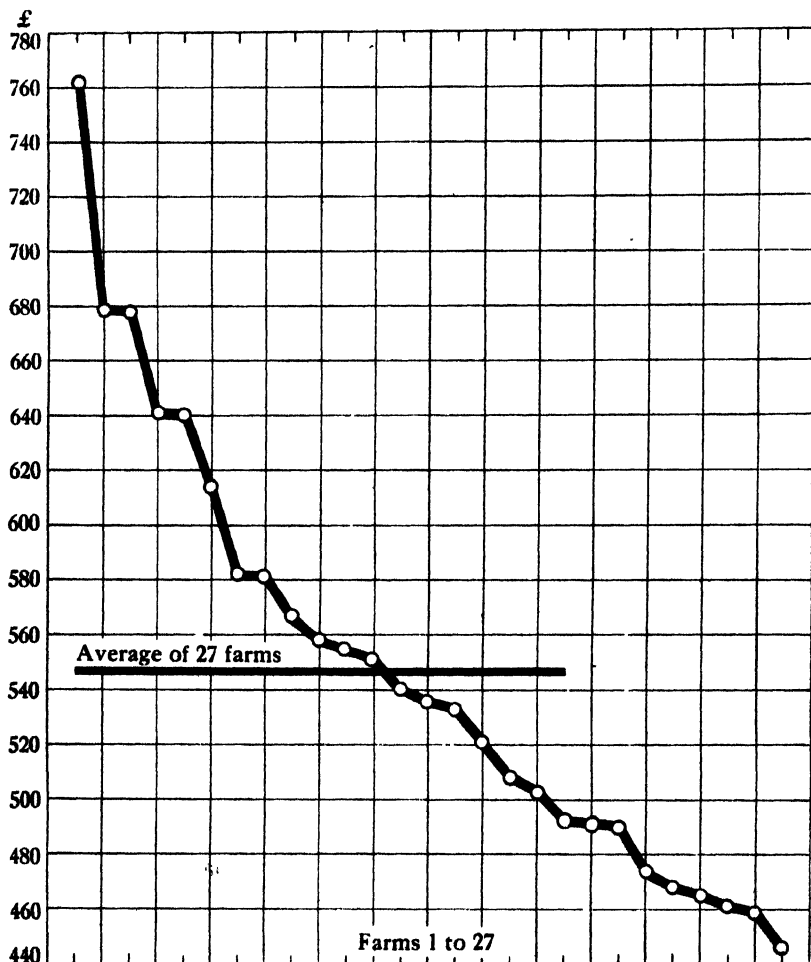


FIG. I. SHOWING SPREAD OF ESTIMATES OF COST OF UPKEEP OF SIX-HORSE TEAM IN CANTERBURY.

variation and farm location; (2) teamster's efficiency; (3) owner's capability in organization and control; (4) area cultivated.

The effects of soil variation and farm location are shown in a graph accompanying the previous article (see *Journal*, December, 1923, page 364), where it is clearly demonstrated that downs-land farming is subject to

greater variation than any other, the annual cost being greater on this type of farm than elsewhere. The cost on light land most nearly follows the average for the whole group.

The teamster is perhaps the greatest factor in the control of expenditure, although it is difficult to separate him entirely from the owner in this respect, as it is the business of the farmer to exercise a careful supervision of the ploughman. On behalf of the teamster it is only fair to say that he is often working under very adverse conditions, living as he does almost continuously with his team from morning till dark, when he returns to quarters often leaving much to be desired. For a worker to give of his best he must be contented, and no man is contented unless he is comfortable. In the investigation it was found that wherever a married ploughman was employed the farmer was satisfied with the work done. The married man is expensive in initial outlay, as he must have a cottage and be allowed a garden, and probably grazing for a cow; but the present indications in Canterbury point to a more general employment of married men on farms. The ploughman can save money on the cost of the team in many ways. For instance, the estimated consumption of chaff on the twenty-seven farms varied from 22 to 40 tons, with an average of 31 tons. The feeding-capacity of six horses cannot vary to such an extent, and undoubtedly wastage is often taking place. A careful ploughman can rectify this in many cases. It is just as important to study the feeding of a horse as it is that of a dairy cow. A man also who spends spare time overhauling implements and harness can save greatly on repairs and breakages, for it is always the neglected implement that has the heavy cost of upkeep.

The owner should exercise a keen general supervision over his ploughman, but his thoughts should mainly be centred on the organization of his cropping-system. The whole trend of his farm practice should be towards the more even distribution of team work over the whole year. The maintenance of team efficiency is another point which should receive the careful consideration of every owner. In making this investigation three methods came under notice: (1) Breeding young horses on the farm, drafting them into the team at about four years of age, and working them their full period of usefulness; (2) buying young broken horses, and working them in the same way; (3) buying young broken horses, working them to full capacity during appreciating years, and before they begin to depreciate selling them at a profit. No definite age can be laid down for quitting a horse under the last-mentioned system, but it is the one likely to reduce replacement and depreciation cost to a minimum, cutting out as it does all losses excepting accidents and deaths. In the estimates given, £30 is the average annual cost of team replacement, £10 of which covers accidents and deaths, and £20 depreciation over the period.

The area cultivated does not appear to influence the total cost considerably, although it has a very serious bearing on the cost of producing individual crops. The cost of tillage operations decreases as the acreage cultivated increases.

The average cost of tillage operations is shown in the table which follows. Table 8 of the previous article may also be referred to

Table 1.—Cost of Tillage Operations—250 Days' Work

(Average annual cost, £548 5s. 8d.)

Operation.	Acres per Day (Average).	Cost per Acre.
		s. d.
Deep ploughing	4.64	9 5
Skim-ploughing	5.13	8 6
Disking	14.00	3 2
Grubbing	13.20	3 4
Heavy harrowing	28.40	1 7
Light harrowing	30.50	1 5
Drilling	14.00	3 2
Rolling	17.77	2 6

In connection with the accompanying graphs the following standards for tillage operations are used :—

Wheat : Skim-plough, deep plough, double disk, grub (twice), heavy harrow, drill, harrow, harrow and roll, cut and cart.

Oats : Skim-plough, deep plough, grub (twice), heavy harrow, drill, harrow, cut and cart.

Green feed : Skim-plough, deep plough, double disk, grub (twice), heavy harrow, drill and harrow.

Rape and turnips : Skim-plough, deep plough, grub (twice), harrow, drill and harrow.

Working on these standards a team of six horses should be able to cultivate, sow, and harvest at the following approximate rate per day, provided that the area of any crop be not less than 20 acres in one field : Wheat, 1 acre ; oats, 1.23 acres ; green feed, 1.2 acres ; rape, 1.4 acres ; turnips, 1.4 acres ; peas, 1.1 acre ; linseed, 1.1 acre. The cost of team work per acre can be calculated for any cropping-system where the daily cost of the team is known, by dividing the daily cost by the daily area for the respective crops as given above.

The total area under cultivation varied very widely as between the different farms, ranging from 131 acres on farm No. 23 to 375 acres on farm No. 12, the average area over the twenty-seven farms being 232 acres. At a casual glance these figures suggest that many farmers are not justified under their present cropping-system in keeping a six-horse team. Taking two farms, one having a high annual cost of team-upkeep and comparatively large area under cultivation, the other a low annual cost and small area under cultivation, it is interesting to note the cost of team work on the crops in each instance.

In ascertaining the cost of team work on crops as shown in the accompanying graphs and tables, the standard tillage operations quoted above have been used in conjunction with the average area worked by a six-horse team in all tillage operations. Having obtained the minimum number of days required to work the given cropping-system, 20 per cent. has been added to allow for extra work performed by the team, and for lost time through breakages and unavoidable stops, such as moving from one field to another and changing of implements.

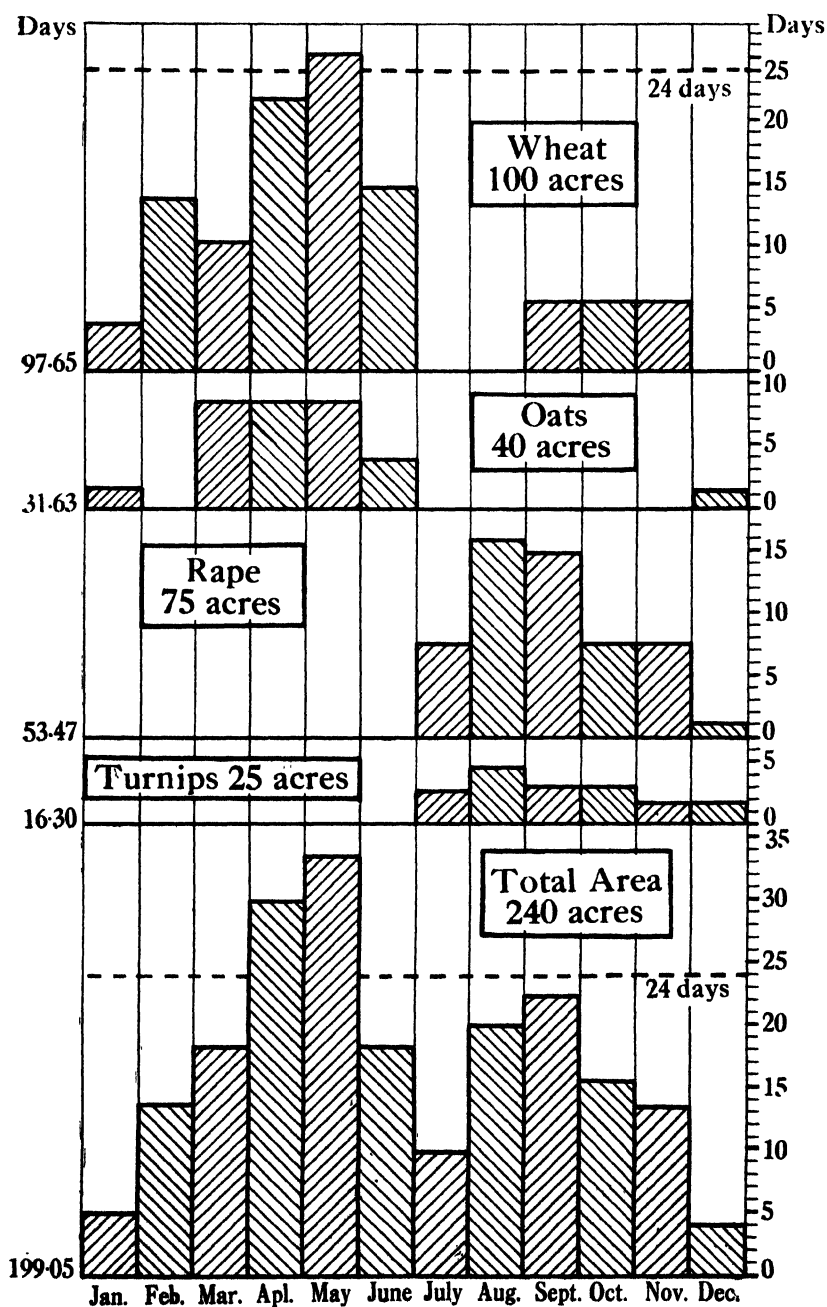


FIG. 2. DISTRIBUTION OF WORK ON FARM NO. 2.

Table 2 : Farm No. 2.

Annual estimated cost of team, £679 5s. 8d. Area cultivated, 240 acres. Minimum number of days worked, 199 + 20 per cent. = 238 days. Daily cost of team, £2 17s.

Crop.	Area.	Cost of Team Work per Acre.		
	Acres	£	s.	d.
Wheat	100	2	17	0
Oats	40	2	4	10
Rape	75	2	0	8
Turnips	25	2	0	8

While making this investigation information was collected as to the approximate dates of tillage operations for the respective crops. Using this information, any system of cropping can be studied diagrammatically, illustrating the number of days worked per month on any crop, and collectively on the whole system over the year. In doing this it has been assumed that twenty-four days is the maximum that can be worked per month, and where any tillage operation is likely to be carried out over two or more months the days required to perform that operation for the given area have been equally divided in the graphs over the months concerned.

It will be seen from Fig. 2 that the cropping-system on this farm (No. 2) is a difficult one. Each column in the graph represents the work for one month, reading January to December, from left to right; and each division in the scale represents one day's work. It will therefore be seen that it is impossible to carry out this programme on the tillage standard set in the present article, as during April and May this area of wheat and oats requires more work than six horses can accomplish. By reducing the area under wheat and oats such modified programme could be carried out at an increased cost per acre.

Table 3 : Farm No. 23.

Estimated annual cost of team, £467 12s. 5d. Area cultivated, 131 acres. Minimum number of days required, 111 + 20 per cent. = 134 days. Daily cost of team, £3 9s. 9d.

Crop.	Area.	Cost of Team Work per Acre.		
	Acres	£	s.	d.
Wheat	50	3	9	9
Oats	20	2	14	10
Green feed	23	2	18	0
Rape	13	2	9	8
Turnips	25	2	9	8

It will be noticed that although the total annual cost on this farm is low, the cost of tillage operations is very high, and it is really costing more to produce crops than on the farm with the high cost of team-upkeep. If the work, as shown in Fig. 3, is studied the reason is obvious. On a farm of this nature two horses should be sold, or the area under cultivation materially increased.

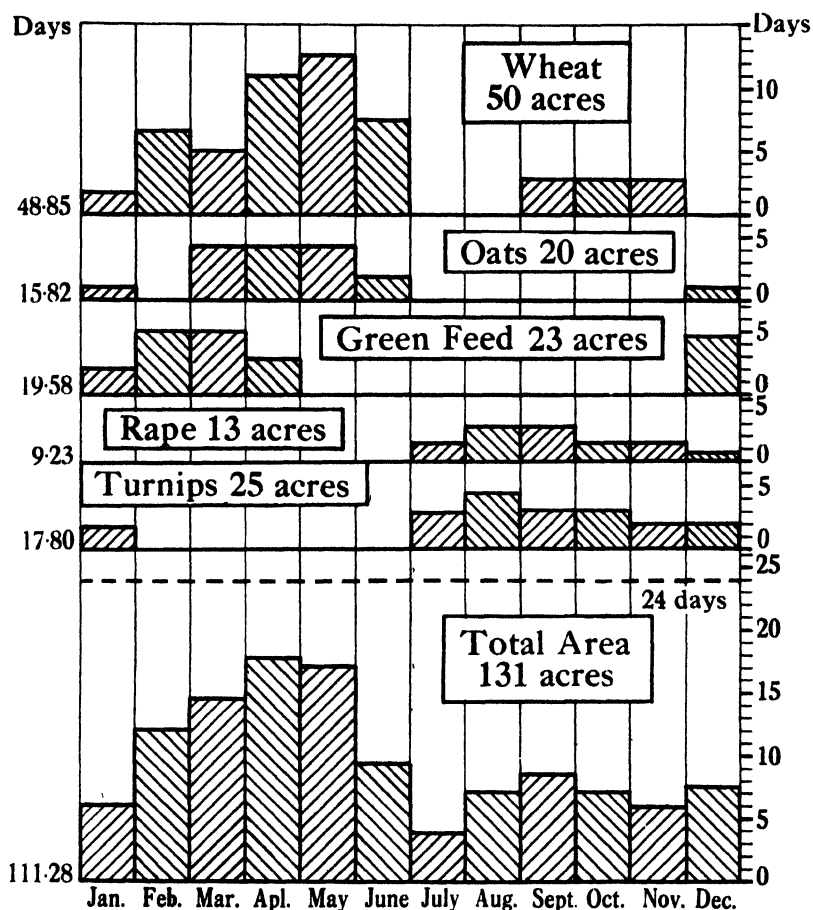
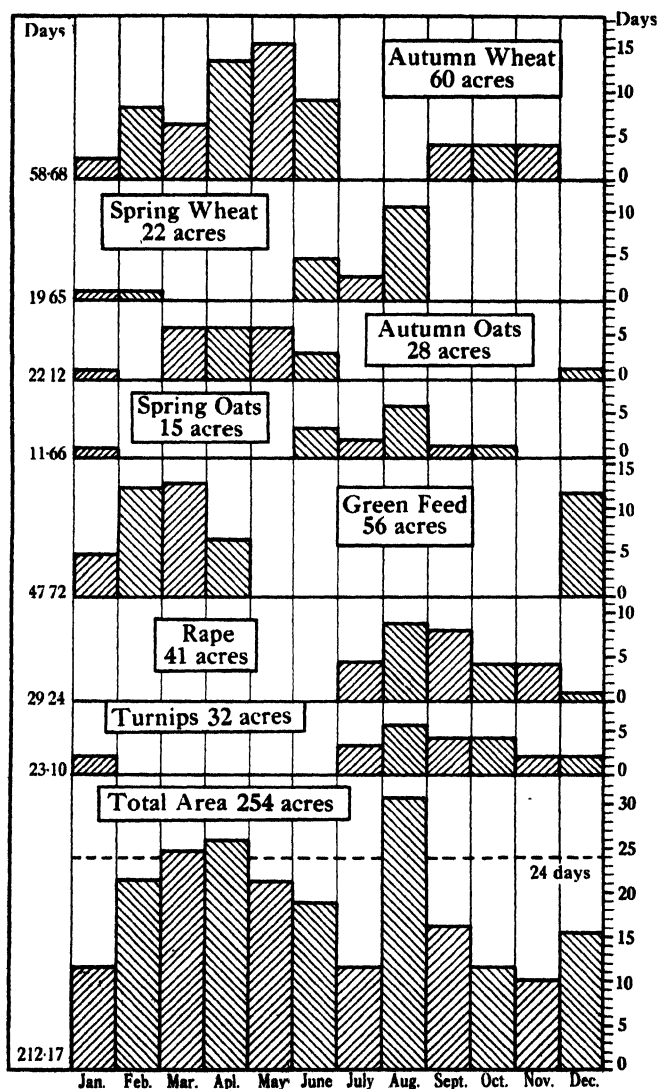


FIG. 3. DISTRIBUTION OF WORK ON FARM NO. 23.

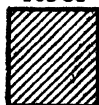
A study of farms working the typical Canterbury programme—namely, wheat, oats, green feed, rape, and turnips—has disclosed a weakness in the system, which, although known by many farmers to exist, has never previously been properly demonstrated. The average areas given by farmers as under cultivation in different crops are as follows: Wheat, 82 acres; oats, 43 acres; green feed, 56 acres; rape, 41 acres; turnips, 32 acres. It is apparent that the whole of the wheat, oats, and green feed cannot be handled in the autumn; therefore wheat and oats have been broken up into autumn and spring sowings, as shown in Fig 4.

It is apparent that the heavy periods under this distribution are February, March, and August. At the foot of this graph the relationship of ploughing to other operations is shown for such a cropping-system. If the whole of the wheat be sown in the autumn, congestion takes place during March, April, and May, with comparative idleness in the spring.



Ploughing

105.86



Cultivation

72.75



Sowing

19.42



Harvesting

8.80



Harrowing

and

Rolling

5.34



FIG. 4. TYPICAL CROPPING-SYSTEM IN CANTERBURY.

The relationship of ploughing to the other operations is shown at foot, the figures signifying days.

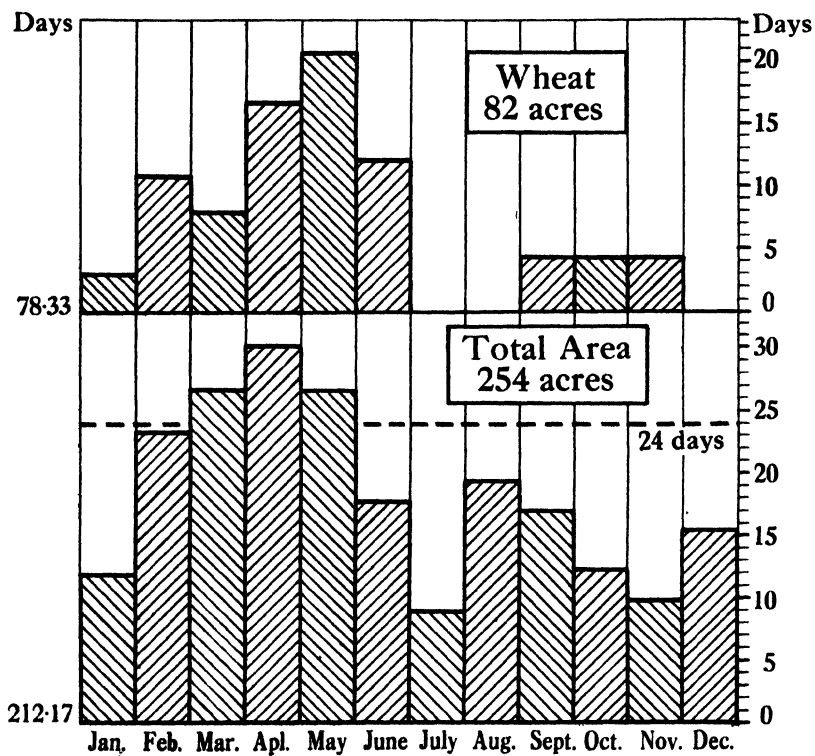


FIG. 5 CROPPING-SYSTEM IN WHICH ALL WHEAT IS AUTUMN-SOWN.

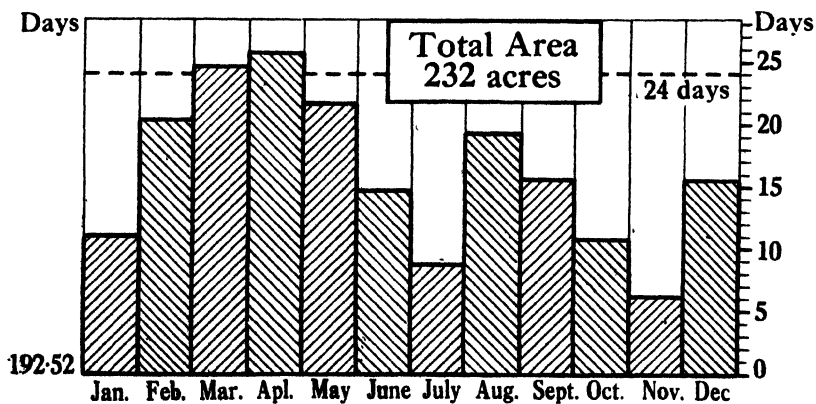


FIG. 6. CANTERBURY CROPPING-SYSTEM SIMILAR TO THAT SHOWN IN FIG. 4, BUT WITH SPRING WHEAT ELIMINATED.

Fig. 5 shows this position, so prevalent in Canterbury. To cope with the autumn work extra horses are kept, and at once the cost of production is raised. It is in this type of cropping particularly that consideration should be given to the advisability of reducing the cropping-programme rather than increasing the team. If the programme is reduced by dropping the 22 acres of spring wheat, otherwise keeping the distribution suggested in Fig. 4, a six-horse team can work it fairly comfortably, the heavy months being March and April (Fig. 6).

A slack period should be felt during the spring, but this can be controlled by growing 20 acres of one or more of the following crops: Linseed, peas, potatoes, swedes, spring vetches—or by fallowing. In arranging this it must be remembered that linseed, peas, and vetches

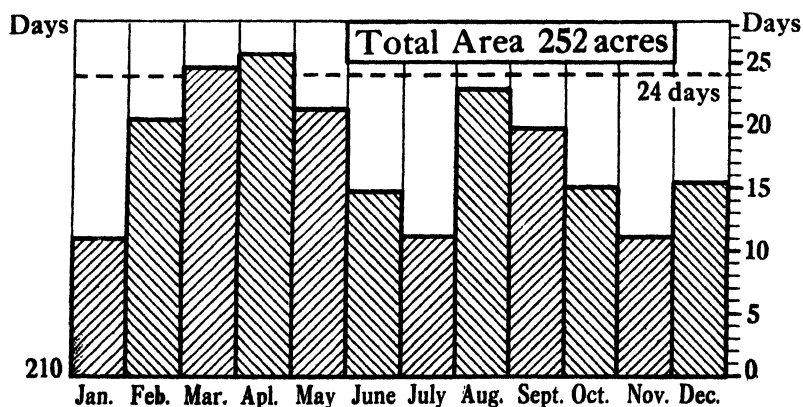
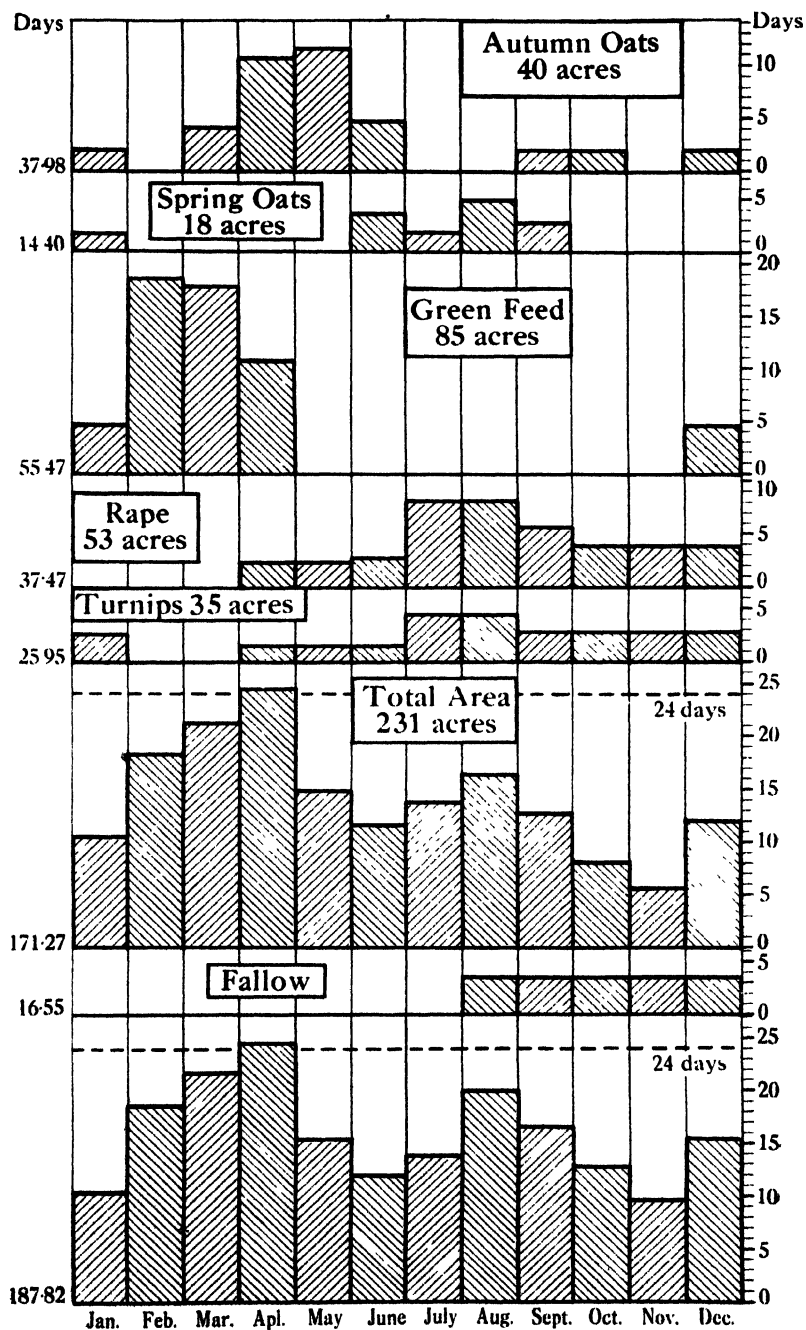


FIG. 7. CANTERBURY SYSTEM WITH SPRING WHEAT ELIMINATED, BUT AUGMENTED WITH 20 ACRES OF OTHER SUITABLE SPRING CROPS.

have to be harvested at the busy season. A safe method, therefore, is perhaps an increase in area of rape and turnips, or growing swedes or potatoes. The other alternative—fallow—is the one which should perhaps be more generally adopted than it is at the present day. If a reasonable area is fallowed each year it can be used for the wheat or green-feed crop, thus reducing the work in the autumn. A programme such as this—252 acres under cultivation—could be worked in the minimum of 210 days, or by adding 20 per cent. 252 days, giving a daily team-cost of £2 3s. 10d. (Fig. 7).

There is another definite type of farming practised in Canterbury—namely, that in which wheat is eliminated completely, the main object being the production of sheep-feed. On this type of farm it is found that the average areas under crops are as follows: Oats, 58 acres; green feed, 85 acres; rape, 53 acres; turnips, 35 acres; and fallow unspecified (Fig. 8).



* FIG. 8. CANTERBURY SYSTEM WHERE SHEEP-FEED IS THE MAIN OBJECT. NO WHEAT GROWN.

The bottom section includes the unspecified area of fallow.

It will be seen that this scheme gives a moderately large area under the plough, but team work is light. Even if a large area were fallowed, the spring should be a slack period; and, again, peas, linseed, spring vetches, or swedes could be grown to advantage (Fig. 9). If this were done the area under the plough could be increased to 251 acres, giving a minimum of 205 working-days, or with 20 per cent. added 241 days, giving a daily cost of £2 4s. 7d.

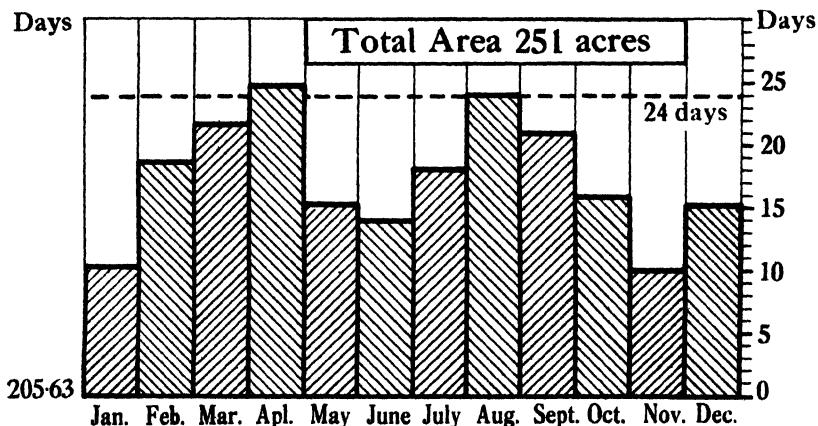


FIG. 9. CANTERBURY SYSTEM AS IN FIG. 8, BUT AUGMENTED WITH 20 ACRES OF SPRING CROPS (PEAS, LINSEED, OR SWEDES).

It appears that under Canterbury conditions the smallest area on which a six-horse team should be kept is 360 acres worked on a six years' rotation. To do this 180 acres would be under the plough, 60 acres to be cropped twice in the year. This would leave 180 acres of grass ranging from one to three years old. The rotation suggested is as follows: Wheat, 60 acres; green feed, 60 acres; turnips, 30 acres; linseed, 30 acres; oats, 30 acres; rape, 30 acres; grass—60 acres three-years-old, 60 acres two-years-old, and 60 acres one-year-old pasture. The work for the team (Fig. 10) shows a slack period in the spring, which can be filled by fallowing if desired; but, as it stands, 240 acres of crop would be handled each year in a minimum of 202 days, or with 20 per cent. added 242 days, giving a daily team-cost of £2 5s. 4d.

Every extra horse kept on the farm costs approximately £44 per annum. If on the farm of 360 acres it is necessary to keep extra horses to handle twitch or any abnormal condition, then the rent of the farm should be reduced £44 per annum for every horse so kept. In other words, if an extra horse has to be kept on a farm of this size the capital value of the land should be depreciated by approximately £2 per acre.

Summarizing the foregoing considerations it appears that greater care should be exercised in the management of farm teams in Canterbury. The object of every owner should be the development of a farming-system calculated to employ the team for the greatest number of days possible, such work to be distributed evenly throughout the year.

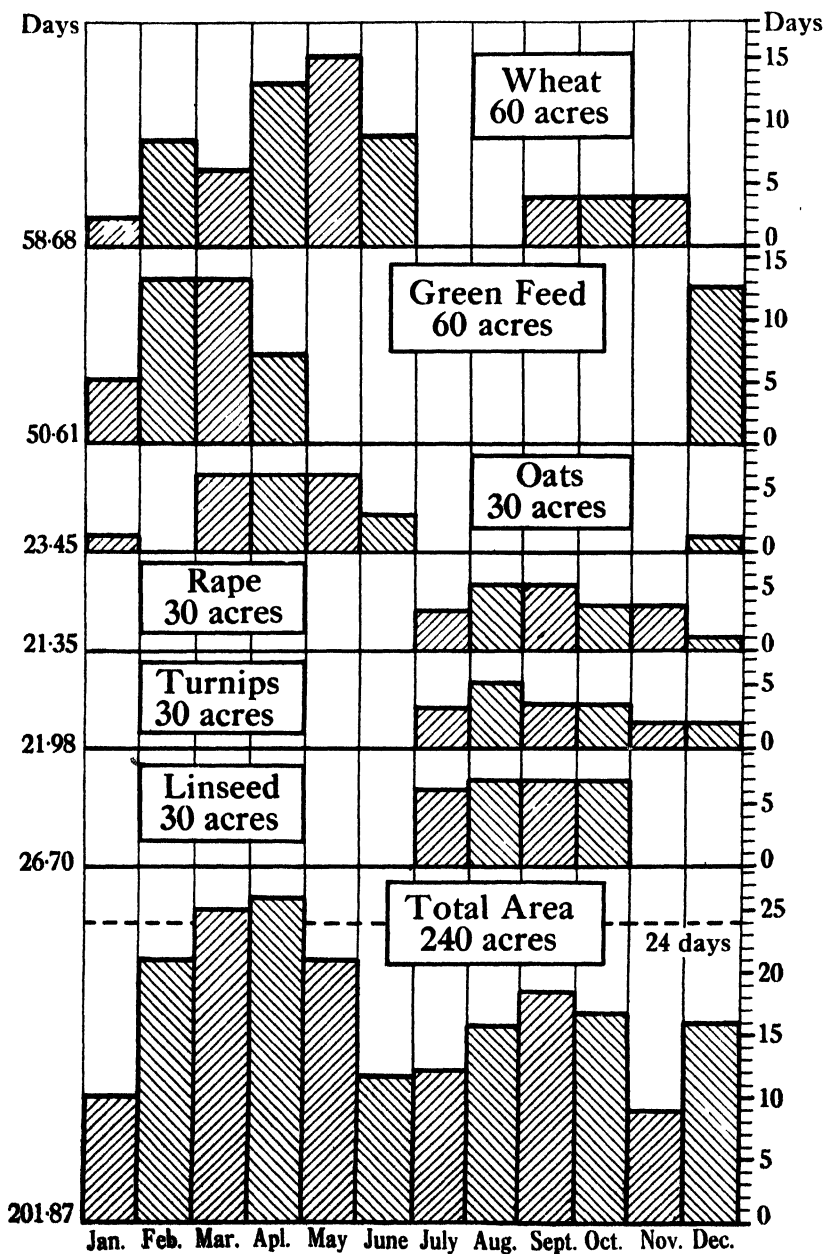


FIG. 10. A CROPPING-PLAN SUGGESTED FOR CANTERBURY.

THE BUSH-SICKNESS INVESTIGATION.

LABORATORY WORK AND RESULTS.

(Continued.)

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

COMPOSITION OF PASTURE PLANTS.

IN examining the composition of the natural food of the ruminants pastured on bush-sick country the inorganic or mineral constituents of the ash have been examined. Some of the results are of considerable interest, and are given in the following pages. The investigation of fodder plants is being continued, especially as regards the grasses and hays of the pumice land.

W. Pfeffer ("Physiology of Plants," 1900, p. 428) states that ordinary plants are fully supplied with iron when 0.2 per cent. is present in the ash, so that an adult maize-plant of 200 grams dry weight, yielding 8.9 grams of ash, would contain 0.016 gram of iron (Fe), and the crop from a hectare ($2\frac{1}{2}$ acres) would equal 200 kilograms of ash, and would remove from the soil 0.4 kilogram of iron. Hall ("Fertilisers and Manures," 1910, p. 270) states that "the plant requires very little iron indeed; as a rule not more than 1 per cent. of the ash of a plant consists of oxide of iron; 2 per cent. might be taken as an outside limit, so that the amount of oxide of iron taken from the soil by a heavy crop of mangolds, the leaf of which is especially rich in iron, only amounts to about 10 lb. per acre." We have thus two estimates for two very different crops—0.4 kilogram of iron (Fe) per hectare for maize (5.6 oz. per acre), and 10 lb. of iron oxide (Fe_2O_3) (7 lb. iron per acre) for mangolds.

Regarding the content of iron in the plant, one meets with difficulties in obtaining good samples of fresh organized material throughout this investigation owing to the great distance of the Department's Chemical Laboratory from the affected country, and the difficulty becomes accentuated when putrescible substances such as animal specimens are dealt with. With regard to fodder-plant research, the contamination of the plants collected from the field by particles of pumice constitutes another formidable difficulty, as the pumice yields to hydrochloric acid more iron than does the plant-ash. Pumice yields about 1 per cent. of iron, and plant-ash about one-fifth of this. Hence the results of plant-ash analysis may be considerably raised by the inclusion of this impurity. The same difficulty has occurred in an investigation in another country. Some results are therefore here given of analysis of clovers grown in pots under glass in order to try to learn something of the iron content of pasture plants. In this series only red clover is dealt with, which is probably the principal fodder plant of the pumice lands. The results show that the iron generally increases in the plant as it matures, whatever the manuring. Hydrated iron oxide appears to be a suitable iron compound to experiment with in the field as a soil-dressing. It has many obvious advantages over spent oxide and ferrous sulphate (sulphate of iron).

The percentage of iron in the first cuts is low (but not so low as is found in plants gathered in the field), a fact which may explain why stock are particularly liable to develop bush sickness in the early

months of summer. There is evidence that the amount of iron in young growth may sink to a quarter (0.05 per cent.) of the amount quoted by Pfeffer (0.2 per cent.). R. Warrington, in Watts's Dictionary of Chemistry (Vol. vii, p. 526, 1883), gives a series of analyses of red-clover samples taken through the spring and summer months (Northern Hemisphere climate) in which the iron is specially given as follows:—

Table 3 Iron in Red Clover

Soil, &c.	Percentage of Iron (Fe) in Ash	Parts of Plant.
First crop—garden soil		
Period I, April 30	0.58	Leaf and stalk.
Period II, May 23..	0.48	Stem, leaf, and stalk.
Period III, June 21	0.65	Stem, leaf, stalk, and bloom.
First crop—field soil		
Period I, May 20..	0.81	Stem, leaf, and stalk
Period II, June 23	1.11	Stem, leaf, stalk, and bloom.
Period III, end of August	1.73	Stem, leaf, stalk, bloom, and seed.

The results may be compared with the low figures given by red clovers grown on bush-sick land (Table 4). The percentage of phosphoric acid present in the red clover is given by the same authority, from which it appears that this constituent is also much higher than is experienced with pumice-grown clovers, and ranges from 11 to 14 per cent. on the ash.

Table 4 Clovers from Bush sick Country.

Sample No.	Month collected.	Locality.	Fodder.	Manuring.	Percentage of Iron on Ash.	Remarks.
C 1316/1	Nov.	Mamaku ..	Clovers and trefoil	Basic slag and super (4 cwt)	0.247	
C 1316/10	Dec	Lichfield ..	Red clover ..	Basic slag ..	0.152	
C 1316/29	"	" ..	Lucerne ..	" ..	0.113	
D 33/11	Jan	Mamaku ..	White clover	Unmanured	0.137	Best land in hollows.
D 33/18	"	Ngawaro	Red clover ..	" ..	0.069	
D 33/19	"	Mamaku ..	White clover	Slag and super (4 cwt.)	0.207	
D 33/23	"	" ..	" ..	Blood and bone	0.156	Lichfield Road.
D 33/26	"	Lichfield ..	Red clover ..	Iron and super	0.126	
D 347/1	Mar.	Mamaku ..	White clover	Unmanured	0.220	Short clover.
D 347/2	"	" ..	" ..	Basic slag ..	0.320	
D 347/3	"	" ..	" ..	Super and basic slag	0.760	Best manure for Mamaku land.
D 347/4	"	" ..	" ..	Super ..	0.270	
D 347/21	"	" ..	" ..	Super, bone, and guano (6 cwt.)	0.194	
D 347/20A	"	Tc Pu ..	Red clover ..	" ..	0.141	
D 347/31	"	Mamaku ..	White clover	Iron sulphate	0.230	
D 347/32	"	" ..	" ..	Super and lime	0.236	
D 347/33	"	" ..	" ..	Lime ..	0.217	
D 347/34	"	" ..	" ..	Potash ..	0.083	
D 347/35	"	" ..	" ..	Unmanured	0.150	
D 347/40	"	Lichfield ..	" ..	Control ..	0.230	

Table 5. Clovers from Normal or Healthy Pumice-country.

Sample No.	Month collected.	Locality.	Fodder.	Manuring.	Percentage of Iron on Ash.	Remarks.
C 1316/20	Dec.	Te Ngae ..	Yellow trefoil	Unmanured	0.323	Swamp land.
D 33/14	Jan	Ngongotaha	White clover	"	0.405	
"	"	Wellington	Yellow trefoil	"	0.640	
D 106/2	"	Moumahaki	Red clover ..	"	1.940	
D 107/2	"	Lincoln ..	" ..	"	0.232	Growing on red pumice. Ditto. Closely cropped. "
D 104/2	"	Collingwood	" ..	"	0.400	
D 347/14	Mar.	Ngongotaha	White clover	Unmanured	0.672	
D 347/13	"	Onuku ..	"	"	0.430	
D 347/15	"	Ngongotaha	"	"	0.495	
D 347/20	"	Rotorua ..	"	Unmanured	0.460	
D 347/23	"	" ..	Yellow trefoil	"	0.473	
D 347/28	"	Reporoa ..	White clover	"	0.529	
D 347/45	"	Ruakura ..	"	"	1.240	

* Manuring (if any) unknown.

Table 6. Percentage of Iron (Fe) in Red-clover Ash from Plants grown in Pots in Pumice Soil

Pot No.	First Cut.	Second Cut.	Third Cut.	Fourth Cut.	Fifth Cut.	Sixth Cut.
1	..	..	0.18	0.38	0.40	0.35
2	..	..	0.18	0.32	0.31	0.33
3	..	..	0.19	0.33	0.28	0.33
4*	0.18	..	0.24	0.35	0.30	0.45
5	..	..	0.20	0.40	0.35	0.45
6	0.16	..	0.18	0.32	0.30	0.45
7*	0.18	..	0.24	0.29	..	..
8†	0.19	0.12	0.17	0.45	} 0.39	0.47
9†	0.21	0.13	0.27	0.42		
10	0.14	0.11	0.14	0.43	0.35	0.40
11	..	0.09	0.18	0.35	0.32	0.41
12	0.13	0.11	0.16	0.40	0.30	0.43
13	0.16	0.11	..	0.47	0.30	0.33
Date of cutting	Dec. 2	Dec. 22	Jan. 16	Mar. 17	June 22	Sept. 2

* Pots 4 and 7 analysed together in last two cuts.

† Analysed together in last two cuts.

The manuring for each pot was—

1. 246 grams carbonate of lime.
2. 82 grams carbonate of lime.
3. 16.4 grams carbonate of lime.
4. Control—no manure.
5. 8.2 grams spent oxide from gasworks.
6. 4.1 grams superphosphate (19.5 per cent. P_2O_5).
7. Control—no manure.
8. 1.23 grams pure ferrous sulphate.
9. 8.20 grams hydrated iron oxide.
10. 4.10 grams basic slag (17.8 per cent. P_2O_5).
11. 4.10 grams Pacific Island phosphate (37.4 per cent. P_2O_5).
12. 4.10 grams basic slag and superphosphate (equal parts).
13. 164.0 grams stable manure, rotted.

The fourth cut must be considered the main crop of this series. It occupied the longest time in active growth, and contained the greatest amount of dry matter.

Table 7. *Percentage of Phosphoric Acid (P_2O_5) in same Pots as in Table 6.*

Pot No.	First Cut.	Second Cut.	Third Cut.	Fourth Cut.	Fifth Cut.	Sixth Cut.
1 ..	..	2.09	4.1	3.28	4.25	5.2
2 ..	..	2.04	4.1	3.01	2.73	4.4
3 ..	..	3.14	3.2	1.97	3.70	5.7
4 ..	2.47	3.84*	3.9	2.00	2.98*	4.4*
5 ..	4.07	..	5.1	3.16	3.12	3.7
6 ..	4.51	5.28	5.7	4.45	5.60	..
7 ..	2.04	3.84*	3.1	2.05	2.98*	4.4*
8 ..	2.80	3.09	3.8	3.61	} 2.90	5.0
9 ..	2.96	4.28	3.5	3.31		
10 ..	4.32	5.46	5.2	7.05	5.17	..
11 ..	4.41	5.53	5.5	6.59	5.96	..
12 ..	4.36	5.65	5.7	6.70	5.65	..
13 ..	3.72	5.16	5.1	5.48	4.90	..

* Control pots' contents analysed together. In the case of the first and second cuts of the limed pots and of the fifth and sixth cuts of the iron-manured pots the contents were analysed together on account of the paucity of the samples.

It will be seen that the mineral phosphates have had the effect of more than trebling the absorption of phosphoric acid by the plant, the slagged crop being particularly rich in this valuable constituent. The effect of the dung is also most marked in the same direction. It will be noticed that large dressings of lime had a retarding effect on the growth of the first and second pots, while the small amount in Pot 3 had so little effect that it may be treated as an additional control pot. The use of culture-pot experiments in the elucidation of manurial problems is often very valuable, but deductions from them must not be considered final until confirmed in the field. The conditions of water-supply in pot experiments are entirely artificial when the tests are carried out under glass, and yet this is the only way in which plants can be secured free from contamination of soil-particles. Compaction of the soil is also an improvement of pumice soils which is effected by potting and watering, and such improvement would not be imitated in the field with similar experiments. For instance, carbonate of lime on pumice soils in pot experiments completes its retarding effect on pasture in a few months, but in the field there is evidence that this effect lasts very much longer. (For turnips in the field the effects of lime are, of course, very much quicker and highly beneficial, even on coarse pumice soils.)

Considering the evidence yielded by analyses of fodder plants from the affected pumice-country, from healthy pumice-country, and from normal country elsewhere, and considering the opinions which are the result of European experience, there is, the writer believes, good evidence to show that the clover-plants from bush-sick land in their most vigorous growing-period have a much lower iron content than normal.

(To be continued.)

Noxious Weeds.—The Wellington City Council has declared hemlock to be a noxious weed within the area under its jurisdiction.

PLANT-SELECTION AND SEED-PRODUCTION.

WORK AT THE MOA SEED FARM.

J. W. HADFIELD, Manager, Moa Seed Farm, Dumbarton, Central Otago.

I. PLANT-SELECTION.

ON every progressive seed-farm a considerable amount of time is necessarily devoted to the production of "stock," "elite," or "stud" seed. This stock seed, which may become the most valuable property of the seed-grower, is not sold, but is used exclusively by him for sowing the crops from which he produces commercial seed. The stock seed thus forms the very foundation upon which reputable seed-production is built, while upon the care and initiative of the breeder depends the quality of the stock seed. The object of these notes is to outline what we are doing on the Moa Seed Farm in plant-selection and the production of stock seed. In a subsequent article the writer proposes to deal briefly with our methods of producing commercial seed.

Soil and climatic conditions play a large part in the appearance and viability of seed; but the appearance of seed which is not itself used for consumption, such as carrot, parsnip, and mangold, except in so far as it indicates satisfactory and careful harvesting, is by no means of such importance as is generally supposed. Viability, though certainly of great importance, cannot become the one determining factor, because it sometimes happens that the highest-quality stock seed is somewhat lacking in this respect. As seed-growers we consider the only true indication of quality is determined by comparative field trials, where it is possible to determine the most important quality or defect in the seed—namely, its varietal purity or trueness to type. This fact is becoming more generally recognized by the grower, mainly as a result of the activities of the crop inspection and certification services of such countries as Canada, the United States, and Denmark. There is also at the present day a definite movement, backed by the seedsmen themselves, to eliminate the large number of synonymous varieties and bring our nomenclature to a simple straightforward basis. The National Institute of Agricultural Botany, at Cambridge, has done a considerable amount of work in this connection, and the United States Department of Agriculture is working on the same lines.

BIENNIAL ROOT CROPS: METHODS OF SELECTION.

The method here described is, in principle, that adopted in the selection of mangolds, beets, carrots, parsnips, and onions. Any crops which have not been grown commercially at the Moa Seed Farm are not here discussed.

Mangolds, beets, and carrots, of which we grow several varieties, are very liable to cross-pollinate, and it is necessary to ensure against this by planting a sufficient distance apart. This is of particular importance in varieties of distinct type and colour, for, while we might take a little risk of cross-pollination between, say, Ox-heart carrot and

Early Horn, we must guard against any possibility of cross-pollination between either of these varieties with a long scarlet or a white variety.

Commencing with a crop grown from the best commercial seed procurable, we make sufficient selections for our purposes when the roots are being dug. Taking one hundred as a convenient number, these are laid out on the ground and fifty are selected, these being those which conform most closely to our ideal. The remaining fifty are reserved as second-quality selections, to which reference will be made later. The fifty first selections are numbered, notes taken if desired, and are stored away over winter in a frost-proof root-store. In the spring, when the main crop is being planted, these selections also receive attention, and are planted, whenever possible, in an isolation plot sufficiently far removed to avoid any danger of cross-pollination with other plants of even the same variety. This is certainly the most desirable method, but, unfortunately, not always practicable on a farm where one's resources are taxed to keep even the main seed crops sufficiently far apart. Under these circumstances we plant the first-quality selected roots in the centre of the main crop, and surround them on all sides with the second-quality selections to which reference has already been made. This we find the best practical method.

When seed is formed the selections are examined, and quite a number are generally discarded on account of poor seeding-properties. This culling is very necessary, since we find a decided tendency for high-quality roots to produce very little seed, and, as we are primarily seed producers, we have to strike a balance between root quality and seed-production. A great deal of variation is to be observed in the seed and seed-bearing parts of carrot, parsnip, and mangold. Most of it is of no commercial significance, but some is. In parsnip, for example, the colour merges into a purple, while other plants produce almost seedless umbels; but the most objectionable property is the tendency of certain roots to produce puffed triangular clusters, the seeds of which contain no kernel.

When the remaining plants ripen seed a little from each of the first-quality selections is reserved, each in a marked packet, for sowing in the trial plots the following season. The remainder of the first-selection seed is bulked, and forms seed for sowing the main crop in the following season. The seed from the second-quality roots is also harvested, and forms a reserve in case of failure, or in case the seed from the first selections is not sufficient to meet requirements.

The seed-samples reserved for the trial plots are carefully examined, and sometimes germination tests are made. The following spring they are sown on well-prepared ground in rows about 1 chain long, each sample in a separate row. Thus each row is the direct progeny of one of the originally selected roots. The area reserved for the trial plots should be in the best possible condition. This is important, since unsatisfactory conditions will induce so much malformation as to completely swamp any slight differences which might otherwise be observed between one row and another. Thinning and cultivation must be done most carefully and uniformly, and an endeavour made to allow each row full and equal development.

When these rows are dug we endeavour to decide on the best and second best. This is by far the most difficult part of the work, and

only in alternate years. This difficulty can be overcome by having a parallel series commencing one year later, or, what is very much simpler, by producing each year sufficient selected bulk seed to allow for planting two main crops.

Onions are far better transplanted in the autumn, after they are thoroughly dry and ripe, but with the hard Central Otago winter we prefer to plant our selections in the spring. Brown Spanish, which is our standard variety, is difficult to select, because the colour of the skin has, we believe, never been fixed.

ANNUAL ROOT CROPS.

Radish is the only annual root crop we have grown at the Moa Farm commercially. Its extreme liability to cross-pollination renders it unwise to grow more than a single variety on any one farm. The method of selection we adopt is the same in principle as that used in the case of biennial roots. The roots, however, are lifted a few weeks after sowing, when the radish is in proper state for eating. Trial rows are judged for flavour, quality, and appearance, and the selected roots are topped and immediately transplanted. They will recommence to grow at once if the soil is moist or the roots are watered after transplanting.

GARDEN PEAS.

Some thousands of acres of garden peas are grown annually in New Zealand on contract, and the firms who let out these contracts employ gangs of men who travel from one farm to the next roguing the crops. The rogues sweep across the paddocks, pulling up all plants which are not of the correct type; and a man trained to this work can pick a remarkable number of rogues out of an apparently pure crop. While this is the approved method, we are doubtful if the expense is warranted by the results obtained. After our first year of roguing on these lines we decided that it would be more effective to devote our whole attention to a small area to be harvested and threshed separately for our own sowing. This, combined with hand picking of seed in winter, resulted in a certain amount of improvement. We believe, however, that it is almost impossible to thoroughly rogue a block of peas, even when these are grown in drills, and that more definite results would be obtained by going through the crop and hand pulling a large number of plants of the correct type. The seed from these would be sown in an increase plot, the produce of which would be sown out for the main crop. We have not tried this method, but having tested many others we believe this to be the most practicable. The ideal, if not the most practicable method, is to raise strains from single-plant selections. This work we commenced in 1920-21, but we are not likely to have sufficient seed of these strains for sowing our main crops till the season 1925-26. This delay is largely due to the slow increase in peas. While, for example, in an average crop oats may yield forty-fold, peas yield only eight-fold. The delay is also in part due to the almost complete failure of the pea crops during the season 1923-24.

The procedure in the case of annual crops is quite simple and straightforward. Selections are made from a main crop, and the seed from each plant is sown the following spring in an individual row. The seed is multiplied from year to year, keeping each strain separate, and

eliminating any which show poor qualities. With peas the process is slow, but we have been able to produce strains which so far have bred quite pure, and for which there should be a good demand at high prices.

Threshing operations are a fruitful cause of varieties becoming mixed; and, indeed, it is not practicable to clean thoroughly the large threshing-mills in common use. To minimize this trouble special mills would have to be built, affording access to all parts, and all ledges bevelled off to allow of no angles and corners on which seed could rest. Apart, however, from the mixing of varieties, peas are inclined to rogue in various ways.

Round peas in a wrinkled variety are a constant source of trouble. They may be due to the presence of a foreign variety having round seeds; on the other hand, they may arise as "sports" in the variety. Round peas picked out of William Hurst, and sown, produced a variety of types, but all round-seeded. We continued to grow the most promising type, and it has developed into a fine-type round-seeded dwarf pea, similar to if not identical with Country Gentleman. A single plant-selection of Dwarf Defiance produced a plant some of the seeds of which appeared to be somewhat round, and the rest wrinkled. The wrinkled and partly round were therefore sown separately, but very few of the wrinkled grew, and these produced entirely wrinkled seed. The partly round or dented seeds produced mainly wrinkled or dented seeds, but there also appeared some perfectly round light-blue peas similar in every respect to the round pea which forms so common an impurity in this variety.

A type of rogue very common in peas is one producing "tare" leaves. The plant develops very prominent tendrils, the leaflets are small, the stipules pointed, and the pods curved. They are generally considered to be degenerates, but we have not had any of our selections producing tare-leaved plants. We did, however, sow the seed of two tare-leaved plants, thinking that they might throw some light on the appearance of round seeds, but they produced, without exception, wrinkled seed.

Stratagem pea has probably never been fixed to the extent that other standard varieties have. It produces, in common with Dwarf Defiance, a rogue that branches well and produces a large number of pods. The pods are flat, blunt-pointed, and light-green in colour; the seed is very wrinkled and of light bushel-weight. At first sight they appear to afford promising material for selection, and we made selections in January, 1921. During the following season they showed very promising results, but in 1922-23 one reverted 3 per cent. and another fully 50 per cent. to the Stratagem type. Curiously, however, our pure lines of Stratagem and Dwarf Defiance have shown no tendency yet to throw these rogues.

SWEET-PEAS.

We grow annually over one hundred varieties of sweet-peas, and any attempt to make a number of selections from each for comparative trials would break down under its own weight. The best we could do would be to select from a few varieties each year. The method we adopt is to go through each variety very carefully, and any plant producing blooms of exceptional merit is marked by being staked and

tied apart from the rest. Every variety that we grow is named and numbered, and has a bag and a hook similarly marked in the drying-shed. Each of these bags contains a tin, and when a variety is being picked any ripe seed from the selection is placed in this tin and reserved for sowing the following season. By adopting this simple method we have brought about considerable improvement and greater uniformity than that observed in any seed we have bought. In sweet-peas only have we carried out any cross-breeding with a view to raising new varieties, but this work would be of little interest to agriculturists.

POTATOES.

We have grown during the last few years a very large number of potato varieties, both of local and of English and Scottish origin. Our main-crop varieties are Robin Adair, King Edward, Sutton's Supreme, Up-to-Date, Sutton's Abundance, and Arran Chief. Of the more recent introductions we have had promising results from The Rector, Arran Victory, Great Scott, Arran Comrade, and Kerr's Pink.

In 1921 we made a number of hill selections from Arran Chief, and have this winter sufficient seed for planting our main crop next spring. This seed will be the progeny of the tubers of a single hill selected in 1921, and which has successfully competed against all the other hill selections. The best we can say for this selection, however, is that it is a pure strain of average yielding quality. Our failure we would not attribute to the principle of hill selection, but rather to faulty selection on our part. The potato, being reproduced from its tubers or modified stems, exhibits little variation upon which to base selection, except in the very rare case of "bud sports." A heavy-yielding hill will not necessarily transmit its yielding quality; it has, in fact, been demonstrated that an average-yielding hill will reproduce more freely than a heavy hill. It is frequently observed, however, that potatoes "run out." This is probably a pathological condition brought about, in part at least, by diseases of which very little is known—for example, mosaic, as well as others that are better known. As some of these diseases are transmitted from year to year, hill selection affords an excellent method of producing disease-free strains—a matter of far-reaching importance in the potato. Were we to succeed with hill selection or tuber-unit selection, as others have before us, we would expect that the measure of our success would be the degree to which we had produced pure strains, free from those diseases to which is attributed "running out."

Seedling Potatoes.

A large number of seedling potatoes in their second and third year were sent to the Moa Farm by the Department of Agriculture. They were originally raised by Mr. J. Beverley, late plant-breeder at the Central Development Farm, Weraroa, and comprised the following crosses: Gamekeeper \times Patterson's Victoria, Gamekeeper \times Sutton's Bountiful, and Up-to-Date \times Ngatiote.

These seedlings are now in their fifth and sixth year, and during the interval a very large number have been discarded. We are concerned only with selection for commercial purposes; but, even so, we find it necessary to take full notes on each seedling both during its growth and at harvest. After the first year we were able to group

them into types, and by planting all of one type together we are able to make better comparisons and eliminate more readily.

At harvest we sort and weigh the tubers of each as table, seed, and pig potatoes. To enable one yield to be more readily compared with that of another we calculate what we term a yield-factor according to the following formula : $\frac{\text{Table} \times 2 + \text{seed}}{N}$. Where N equals the number of shaws in the row, or, in the case of very long rows, we make calculations on ten or twenty shaws at intervals. We double the table potatoes because we consider, from a commercial point of view, the table sort to be of proportionately greater value than the seed. This also enables us to group them according to yield, and though we make no hard-and-fast rule we generally discard any with a yield-factor below 1, or any which we consider to be of no commercial value. The remainder we treat as follows :—

Yield-factor	1 to 2—	plant out	10	tubers.
„	above 2	to 3	20	„
„	„	3 to 4	30	„
„	„	4 to 5	40	„
„	„	5 and over	50	„

At the present time we have about half a dozen seedlings which we are increasing with a view to further trials in different districts, and, if successful, placing them on the market. Cooking-tests of all the most promising will be carried out this winter.

We are, in common with other potato-raisers, beset with the danger of producing a seedling similar in appearance and habit to a variety already named. In our lists of synonyms, taken from the records of the English and Scottish synonym trials, we have a list of over one hundred varieties synonymous with Up-to-Date, and we quite expect to discard some of our seedlings for similar reasons. In fact, the most promising seedlings of the 1922-23 trials prove to be identical in appearance with Great Scott, and one of the most promising in the 1923-24 trials to be very similar to Arran Comrade.

OBJECTIVE AT THE MOA FARM.

In concluding the plant-selection part of these articles the writer would like to point out that such work as we have done at the Moa Farm has been with a definite commercial objective. Though often tempted, we have refrained from experimenting along lines of purely scientific interest unless we could see that it might lead us to information of direct value in the commercial production of seed. For a similar reason we have not endeavoured to produce new varieties, except to follow up certain pure strains of peas. We consider, in fact, that there are far too many varieties already on the market, and our aim has been to grow and try to improve recognized standard varieties. We must, however, except sweet-peas, for in this case the varieties change as the fashions, and it is imperative for us to raise new varieties by cross-breeding in order to keep abreast of the times.

(To be continued.)

THE RELATION OF BIRDS TO AGRICULTURE IN NEW ZEALAND.

X. THE KEA OR MOUNTAIN-PARROT.

J. G. MYERS, Biological Laboratory, Wellington.

THE highlands of the Old World have their eagles to inspire the enrichment of folk-lore with tales of avian daring and rapacity, of children carried to inaccessible heights; the Alps of Switzerland find the embodiment of their own far-soaring grandeur in the famous *lammergeier* or so-called bearded vulture; the Andes afford fit resting-place among their fastnesses to that greatest of all the birds of prey, the condor. It remained for the New Zealand Alps to appoint a genius loci over their solitudes, and to choose in accordance with the uniqueness of the native avifauna. No birds of prey were here appropriate to the task; the gigantic eagle of the ancient days is gone, and a parrot lords it over the mountain-slopes above the forest. The parrots, those brightly plumaged bird pets of the world, seem vividly incongruous with the austere topography and rigorous climate of the heights; yet who shall say the subject of this article, winging its powerful flight over the highest ridges or echoing its weird and melancholy call of "kea, kea" across the gorges is not in keeping with the magnificent desolation of the scene.

Such a haunt for a parrot is sufficiently remarkable to have rendered the kea famous in the annals of bird-lore; but the early reports of its alleged sheep-killing made it notorious throughout the world, till not a popular natural history could be published without a reference to the mountain-parrot of New Zealand and its unparalleled change of diet from grubs and berries to live sheep; until not a museum in the Dominion was complete without a caricature of a mangled sheep gory with sealing-wax blood, and a stuffed specimen of the unholy bird engaged in its feast.

In the mind of the man in the street this, then, is the position regarding the kea. It is the aim of the present writer to sift the available evidence and to present the data on which a strictly scientific opinion can be based. At the outset it must be admitted that the evidence collected since the first rumours of sheep-killing in the "sixties" is meagre in the extreme, and affords a striking illustration of the scanty and shiftless foundations which often suffice to support a colossal edifice of popular theory. The information is at present totally insufficient to enable anything more than a few guarded conclusions to be drawn, and a few suggestions to be made as a basis for future investigation of one of the most pressing problems New Zealand has to offer in economic ornithology.

THE BIRD ITSELF.

Seen at close hand the kea (*Nestor notabilis* Gould) is a sizable bird, about as large as the New Zealand wood-pigeon, but of a different build. The beak, with the long curved keen-pointed upper mandible, at once attracts attention by its powerful aspect and sinister

appearance. To the worst that has ever been said against the kea its beak will never give the lie. The plumage, olive-green with black edges to the feathers, possesses a quiet beauty of its own, enlivened with a vivid charm when the act of flight displays the gorgeous red feathers lining the wings and covering the base of the tail. The legs are longer than those of its exclusively forest-dwelling but closely related cousin, the kaka (*Nestor meridionalis* Gm.). Extra length of leg is often an adaptation to ground-dwelling habits, and *vice versa* the most aerial of birds—petrels, swifts, humming-birds, and so forth—possess the shortest legs. The differences between the sexes in the kea are not striking, but the male is said to be recognizable by its longer and more powerful beak.

The mental characteristics of the kea are fully in keeping with its systematic position as a member of the parrot family. No traveller in its haunts fails to remark on its never-failing curiosity and engaging familiarity. Its innate playfulness is tinged like that of a puppy with mischief, and tempered with a wit beyond the wisdom of birds. In the neighbourhood of camps it is often a decided nuisance from its depredations on tents and equipment.

BIOLOGY.

Of the life-history of the kea suprisingly little is known. Even at the present day very few naturalists have ever seen a nest. There is therefore little agreement even on such a simple question as the number of eggs laid. Thus, some will have it that there are never more than two eggs, while others state that they have found as many as seven. Taking everything into consideration, it seems probable that Mr. A. F. O'Donoghue's estimate of four to six, founded largely on personal experience, is as correct as any one's. The time of nesting and the number of broods per year are also doubtful. Marriner in his book on the kea, after stating somewhat dogmatically that "the kea's breeding season commences about June, and is continued on to September or even later," and even building one of his most favoured theories of the origin of the sheep-killing habit partially on this alleged fact, shows elsewhere that Mr. E. F. Stead found a nest in January. There is, of course, nothing inherently impossible in the assertion that the kea nests in midwinter—the Emperor penguin chooses this of all seasons in the Antarctic, as do also very frequently several species of shags in New Zealand. Many more authentic observations are required, however, before the evidence for such a habit can be considered established in the kea's case.

Uncertainty concerning the nesting-habits of the kea has been engendered largely by the inaccessibility of the site. The pure-white eggs, about as large as a pigeon's, are laid in holes in the cliffs or crevices among the rocks, often in such positions that even if located the nest remains out of reach. Finally, when all other difficulties are overcome it may be found that the actual breeding-chamber is at the end of a tunnel so long that even a crow-bar is insufficient to force an entrance. For this reason, if for no other, it is probable that the kea will ever survive in its mountain home. In this connection Dendy writes: "It is highly instructive . . . to contrast the condition of such a bird as the flightless parrot, or kakapo, with that of its relative the kea. The



FIG. 1. THE KEA (*NESTOR NOTABILIS*).

This photograph was taken under difficult conditions, and the bird's head and beak have been somewhat unduly reduced in size by the camera. The head of the kea, in general, is decidedly large in proportion to its body.

[Photo by H. Drake.

kakapo is a large, heavy bird of nocturnal habits, and with practically no means of defence; it haunts the dense forest, and is rarely seen except when hunted out by dogs. The kea, on the contrary, is one of the strongest fliers of the parrot tribe. It frequents high and more or less inaccessible mountain regions, and since the advent of the Europeans has learnt to make use of the sheep which they have introduced as an additional food-supply. It is doubtful whether the utmost efforts of the sheep-farmers, who annually spend large sums of money for the purpose, will ever enable them to exterminate the kea, and it

is equally doubtful whether the efforts of the New Zealand Government to preserve the unique flightless birds will suffice to prevent the complete extermination of the kakapo within the next few years."

The haunt of the kea is essentially subalpine. It is found only in the mountains of the South Island. On these its chief habitat comprises the open country just above the bush-line. Here it is that the present writer has observed it, and the experience of other naturalists is similar. Thus Park writes: "The kea is seen at all altitudes above 2,000 ft., but its favourite haunt during the daytime is the grassy mountain-slope above the bush-line. At night it perches on the limbs of dead trees at the upper edge of the forest, somewhere about 3,000 ft. above the level of the sea. In stormy weather the kea will occasionally descend to the floor of the mountain valleys, and perch at an altitude of 1,000 ft. or somewhat less above the sea." L. Cockayne, after a wide experience of the kea, states: "Although frequently met with on the open alpine and subalpine hillside, I consider the bird essentially one of the forest limit, where it may be seen in numbers at the junction of the forest and subalpine meadows and in the *Nothofagus* forest where such are pierced by river-beds." Stragglers may even venture down practically to sea-level.

The question as to what constitutes the natural food of the kea is one of considerable interest, and is fortunately one on which more reliable data are available than on any other aspect of the kea problem. Marriner's account is good, and may be quoted with advantage:—

The kea, like other parrots, is normally a vegetarian, with, as one might expect from its connection with the brush-tongued parrots, a strong liking for honey. In addition to this it is strongly insectivorous, being specially fond of the larvæ of the insects found on the mountains.

The late Mr. T. H. Potts says that the kea gathers its subsistence from the nectar of hardy flowers—from the drupes and berries of dwarfed shrubs that contend with the vigorous climate and press upward almost to the snow-line of our alpine giants. To these food resources may be added insects found in the crevices of rocks, beneath the bark of trees, &c. . . .

When the snow covers the subalpine shrubs, or insect-life is dormant, the kea is forced to go lower and lower down the mountain to take shelter in gullies, where it feeds on the hard bitter seeds of kowhai (*Sophora tetralpera*), small hard seeds in the fruit of *Pittosporum*, the black berries of *Aristotelia fructuosa* (the native currant), as well as on the fruit of the pitca-pine (*Dacrydium biforme*), and the totara (*Podocarpus totara*). . . . Professor W. B. Benham, when in the Southern Alps, saw some keas eating the orange berries of the low-growing heath, *Leucopogon Fraseri*. He says: "Two birds were feeding on these berries within two yards of where I was sitting; they ate the juicy part of the berry, putting out the skin, and usually the 'seed' also, which I found afterwards on the ground, though now and then I heard the bird crack the seed; so that occasionally, at any rate, it swallows this."

A correspondent writing on this subject says: "I have watched the kea pecking grubs out of a dead tree, and have frequently noticed them pecking into the earth for the roots with their beaks."

Another says: "I have shot very few [keas] that have not had mutton in their crops, and next to that some grubs and the roots of aniseed. In summer and autumn they go for berries such as snowberries, &c., and also the honey out of the flax-seed (*Phormium tenax*)."

Other observers found the kea feeding on the roots of spear-grass (*Aciphylla* spp.), of so-called mountain-lily (*Ranunculus Lyallii*), and of mountain-daisies (*Celmisia* spp). Mr. A. Philpott has paid attention

to the food of the kea. He states: "In January, 1917, the mountain-flax (*Phormium Cookianum*) was in flower, and little flocks of keas might daily be found sucking the nectar from the blossoms. On more than one occasion keas were observed breaking off and splitting up the flower-stalks of the celmisias. The soft central portion of the stalk seemed to be the part desired, for though I examined the refuse in order to ascertain if it was caterpillars or some other form of insect-life that the bird was after, I could find no trace of such. The gizzards, however, of a few which were captured showed that insects formed a large proportion of their food, remains of the larvæ of *Cicadæ* being plentiful. Though the kea may often be seen stripping off the lichen and moss from the branches of trees, the bird does not seem to bore into and break up decayed wood as its congener the kaka does; probably *Nothofagus* logs do not contain sufficient insect-life to make it worth while."

The present writer and Mr. Esmond Atkinson (this *Journal* for May, 1923) have previously emphasized the large proportion of forest plants producing berries which are eaten (and the seeds thus dispersed) by birds. As the subalpine plants are not behindhand in this respect, the kea has at certain times of the year a plentiful food-supply.

A question of great importance in kea biology has yet to be mentioned—namely, the bird's movements. There is, of course, good evidence that heavy weather on the heights will drive keas to lower levels, but a matter that needs investigating is that of more extensive migration. It is frequently asserted that reserves and mountainous back country act as centres in which keas may retire to breed, and from which they sally forth over wide areas to harass the sheep. On the other hand, nearly all available data point to the conclusion that except for oscillations in altitude consequent on meteorological conditions the keas of a given area are resident, and do not seek food over wide tracts of adjacent country. Further information on this point is eminently desirable.

DISTRIBUTION.

The kea occurs nowhere else in the world but in the mountains of the South Island of New Zealand. Formerly, as indicated by the finding of fossil bones, it inhabited also the Chatham Islands, while if Maori tradition be correct it was once found in the Urewera country of the North Island, from which district it apparently disappeared before the advent of the Europeans. According to Best, the Maoris describe it as smaller than a kaka, brown or reddish, with a different beak, and state that it lived in the open country.

Be this as it may, the kea is certainly now confined to the South Island. According to Marriner, "wherever there is mountainous country in the South Island, with the exception of the Kaikoura Mountains in the north-east, the kea can be found." It is now, however, more plentiful in the Marlborough District than when Marriner wrote.

There is a considerable body of evidence to show that the kea has extended its range since it was first discovered. This extension has taken place largely in a northerly direction. For example, the first keas to be seen in northern Nelson were not observed till 1903-4, and even now, though an occasional bird is seen, they are not common.

The explanation of this spreading is not easy to find. Marriner, however, suggested that increased food-supplies in the form of dead sheep (the proof that the kea eats carrion is undoubtedly complete) led to a multiplication of the species and consequent overflow into districts hitherto not frequented. On the other hand, the backbone range of the South Island still remains the stronghold of the kea, and most of those seen in distant localities are probably stragglers which may previously have escaped notice under conditions of sparser settlement.

HISTORICAL.

The history of the kea since its discovery may be considered under the following headings:—

- (1.) Period of ornithological interest only (1856-67).
- (2.) Period of suspicion (1867-70).
- (3.) Period of traditional condemnation (1870-99).
- (4.) Period of critical investigation (1899 and onward), initiated by L. Cockayne.

In 1856 Mantell while exploring in Southland discovered this new mountain-parrot, and it was soon afterwards described by Gould, Australian ornithologist. Little did Gould dream when he named it *Nestor notabilis* how notable it was destined to become.

The story of the first suspicions of sheep-killing may be told in Marriner's words:—

When killing sheep for home consumption, on the Lake Wanaka Station, north-west Otago, in 1867, the shepherds noticed from time to time what they took to be a new disease on the loins of the animals, and during shearing, in 1868, these mysterious scars were again observed. On close examination the supposed disease revealed severe wounds in different stages of healing or festering. On some sheep there was merely a patch of bare skin, but on others there was either a half-healed wound or a raw patch of festering flesh, while others, again, had each a large hole torn in the side, from which the entrails were often protruding. . . . Suspicion fell at once on the black-back gull and the harrier-hawk, but it was soon pointed out that it was only the sheep of the alpine country that were attacked, while the gulls and hawks scoured the plains as well as the mountains. It was a well-known fact that the gulls would pick at the eyes of a very young lamb, or even at a sheep when it had fallen, but they had never been known to attack the sheep over the loin in the manner of the unknown culprit.

This began a period of suspicion, and suspicion very soon in the popular mind crystallized into dogmatic certainty, as keas were first seen picking meat and fat from skins and from carcasses, and were observed feeding on the bodies of dead sheep. Finally it became generally believed that shepherds had watched the birds actually attacking the living animals. Incredible as it may seem, there was, however, up till 1909 not a single recorded case of a witness who had actually seen a kea attacking a sheep. Nevertheless the statement was circulated throughout the world, received general credence, and in New Zealand became an article of national faith. Even Buller wrote that the depredations of keas were forcing sheepowners to give up their lands.

The first to question publicly the evidence—but with a quite open mind—for the accepted theory was Dr. L. Cockayne, who asserted in 1899 (given as 1905 in Marriner's book) before the Philosophical Institute of Canterbury, after considerable experience of kea country: "I have never seen it attack sheep, nor have I ever met with any one—

shepherd, musterer, or mountain traveller—who has done so; the most that my inquiries have elicited is that sheep are found from time to time with holes in their backs, and that keas have been seen hovering round sheep." In the general discussion that followed no one was able to offer any more direct evidence.

This occasion initiated that period of critical investigation, the first-fruits of which were two notable contributions to the subject in the form of a paper by Benham and another by Marriner, both published in 1907. In the former are reproduced the accounts of some ten eye-witnesses, while in the latter over thirty sheepowners and shepherds are claimed to have actually seen the kea at work. It is, however, noteworthy that Marriner, although he made a special investigation of the whole matter and spared neither time nor pains to see for himself, gained not a particle more of first-hand evidence than was afforded by the bodies of several sheep said to have been killed by keas.

Marriner's paper was later published in book form under the title of "The Kea: A New Zealand Problem." This has now become an authority in the popular mind on the kea and its habits, although the article on which it was based contained more detailed information, and, in company with Benham's paper, should really be considered the standard reference work. An examination will presently be made in detail of the evidence adduced in these publications.

For a considerable period previous to 1906 the subsidy on kea destruction paid by the Government (and often increased by the subscription of local bodies or of sheepowners themselves) was 6d. per head. From 1906 till 1920 the Government paid 1s per beak, but in the latter year the subsidy was raised to 5s. For the six months before the increase payment was made on 927 beaks; for the six months immediately following 1,388 were brought in. The added impetus given to kea-hunting by the augmented price is a significant fact. The number of beaks paid for by Government in the financial year 1923-24 was 4,023; in 1923, 3,584; and in 1922, 6,315.

SHEEP-KILLING.

As we have already seen, the recorded evidence against the kea up till 1907 was not only circumstantial merely, but so utterly flimsy and founded on hearsay that it could be considered seriously only as an indication that the matter was worth investigation. But such investigation was not thought of until 1899, and it yet remains to be carried out with the proper methods of biological inquiry.

Considering first the evidence against the bird we find this nearly all collected in the works already referred to. Marriner sums up the points of agreement among the eye-witnesses who communicated with him, and writes as follows:—

Usually one or two old birds, known as "sheep-killers," do the killing, and the others share the spoil. It is quite a mistake to suppose that all keas kill or even attack the spoil. Just as we have comparatively harmless tigers, who will not attack man except under provocation, and also "man-eaters," who seem to take a special delight in killing men, so, among the keas, many of them never attack sheep, while others, usually old birds, seem to enjoy nothing better.

The usual mode of attack seems to be as follows: The bird settles on the ground near its quarry, and, after hopping about here and there for some time,

leaps on to its prey, usually on the rump. If it cannot obtain a firm grip with its claws the movement of the sheep may cause it to fall, but the kea seems rather to enjoy the sensation, and so tries again until it has securely perched itself on the sheep's back. Then the murderer begins to cruelly pull out the wool with its powerful beak, until it gets down to the flesh. The sheep, which for some time has been moving uneasily about, gives a jump as the beak enters the flesh, and then commences to run wildly about here and there in vain efforts to rid itself of its tormentor. When, however, the poor beast discovers that it cannot dislodge its enemy it seems to lose its head, and rushes blindly about, usually at a high speed.

Sometimes the birds run the sheep to death, and then gorge themselves on the dead body. At other times they never reach a vital part of the animal's anatomy, but after severely wounding it they leave it, and the poor brute wanders about with a large gash, sometimes 4 in. or 5 in. across, on its rump, and torn open so much that the transverse processes of the vertebrae can be seen. The sheep struggles along until blood-poisoning, caused by filth and exposure, sets in, and the unfortunate beast lies down and gives up the struggle.

Marriner himself saw "three sheep that had been attacked in this way by keas." In one "there was an ugly wound on the rump about 11 in. from the base of the tail, the gash measuring 4 in. by 5 in. in width and about 2 in. deep. One half had been torn down to the sinews, while the lower half was eaten down to the bone; the body cavity, though just pierced, did not seem to have been disturbed." It should be mentioned that worse wounds have been described in which portions of the intestines had been actually dragged through the holes. Marriner further writes:—

The greatest damage is done to flocks in winter, when the country is snow-bound. In the mountainous regions the sheep are usually kept down on the lower country until the mountains get a good coat of snow, for once the tops are covered there is very little danger of the sheep going far in the snow. However, if the sheep have been allowed to remain on the tops of the ranges until the snow comes, as is sometimes the case on a big run, they gather together in a basin near the summit and are buried by the snow. It is at this time that the kea finds them an easy prey. . . . Winter and early spring are the periods of the year when the keas are most aggressive in their attacks on sheep, and this fact seems to intimate that the lack of ordinary food does much to instigate the attacks, for a heavy winter generally means a heavy loss of sheep, apart from accidental losses. . . . Not only is food scarce in winter, but the sheep are easier to kill, for the heavy snowstorms which cover the country bury or half bury a large number of sheep, and as they are in many cases unable to move they become an easy prey to the hungry birds. . . . Their attacks, however, are not altogether confined to any special time, for they have been known to attack sheep at all seasons of the year. Still, from what I can gather, autumn seems to be the time of fewest attacks. No doubt the plentiful food-supply, and perhaps the fact that the sheep have been shorn, thus giving the birds a poor hold on the animals' backs, account for this. . . . All my correspondents agree that the favourite times of the day for the bird to commit his depredations are the early morning and the evening; for, like its cousin the kaka, whether killing sheep or not, it is always lively at these times. For this reason it is difficult to obtain photographs of the birds actually attacking sheep, for the lack of light and the absence of the shepherd at these times make the chance of obtaining a snapshot extremely small. They have been known to attack at all hours of the day, but they seem to confine most of the work to the early or late hours. When attacking in the middle of the day it is nearly always in dull or foggy weather, though rare cases are known of their killing sheep even in bright sunshine.

The rump is chosen as the point of attack apparently because it offers a firm and convenient perch, and not because the bird has any special liking either for the kidneys or the kidney-fat. The crude traditional belief, as accepted and widely popularized by various writers, was that the kea chose the kidneys as a special delicacy and always sought out these organs. As a matter of fact, it is said

to eat them very rarely indeed. The same theory held that the kea was led to attack sheep from their resemblance to those huge mountain cushion-composites (*Raoulia* and *Haastia*) commonly known as "vegetable-sheep," from which the bird obtained its primitive and innocent repast of grubs and other insects. This ingenious hypothesis has been severely criticized and is now no longer held. Not only has the resemblance of these plants to sheep been greatly exaggerated, but according to Marriner they are not torn open by keas in search of food, nor, further, do they occur in the regions where the bird was first accused of sheep-killing.

Hunger and that insatiable curiosity which has been so often remarked are now considered to have been the chief factors in leading the kea to attack sheep. Reischek is the author of the very probable suggestion that long-dead carcasses infested with maggots were first visited by keas for the sake of these insects; then the carrion itself was eaten, and finally the living sheep, especially if bailed up by the snow, were attacked. It is also well known that skins hung on fences and meat suspended from gallows are visited by these birds and also by white-eyes and kakas for the sake of the fat. The beginning of the habit may be readily comprehensible—indeed, the wonder would have been had the kea not paid any attention to the sheep as a source of food.

Perhaps the most conclusive evidence adduced since the publication of Marriner's work is afforded by a small photograph in the possession of the Lands and Survey Department. This shows a live sheep with a hole in the neighbourhood of the loins and one kidney visible, apparently having been half pulled out.

In estimating the damage done by keas some most exaggerated statements have been made. Marriner, however, after studying all the evidence, stated: "Reckoning over the whole kea-country, I am certain that 5 per cent. of the flocks would well cover the annual loss due to keas." But at the outset it must be emphatically maintained that, as the birds eat carrion, all dead sheep found with wounds similar to those usually attributed to keas are not necessarily killed by keas. It has so long been the custom in kea districts to write off a very big proportion of the annual loss of sheep as due to keas that the loss due to other causes, notably to the rough nature of the country, appears to be largely overlooked. Guthrie-Smith, writing as a sheep-farmer of lifelong experience and a scientific observer of unimpeachable accuracy, states: "In a well-managed, well-fed, and carefully culled flock running on perfectly safe country, 2 or 2½ per cent. is about the normal death-rate. It is the unavoidable loss incurred through diseases more or less akin to those causing death in the human race. On Tutira, however, a minimum loss of 5 per cent. has never been quite reached; it is the toll paid by the station to cliff and bog. . . ." Tutira is in northern Hawke's Bay, in country which, though including an area of deep gorges, cannot be compared for general roughness with the average of sheep-stations in the regions inhabited by the kea. In these regions the musterers are necessarily mountaineers, and there can be no more precipitous country carrying sheep in the world. It would be interesting to know just how much of the high death-rate due to these abnormal conditions and to the rigours of the mountain winter is attributed to the kea.

It is always difficult to prove a negative, but having shown the evidence indicating the kea as a killer of sheep we now proceed to examine the witnesses for the defence. Cockayne's remarks have already been quoted, and it may be safely asserted that in every case, save one, when an impartial investigator has relied on his own observations, the result has been in entire agreement with Cockayne's statements. The single exception is that of Marriner, who saw three dead sheep which were alleged to have been killed by keas.

Professor James Park, in a recent geological bulletin, writes as follows :—

In his travels in this and Lake Wakatipu regions the author was unable to gather from the runholders or the shepherds any evidence that would substantiate the charge of sheep-killing laid at the door of this bird. In the summer of 1880-81, while assisting Mr Alexander McKay in a geological reconnaissance of the Ohau, Wanaka, and Matukituki country, diligent inquiry among the shepherds failed to disclose any satisfactory evidence of the rumours then beginning to find their way into the newspapers which credited the kea with sheep-killing. In every case that was investigated the bird was found guilty on second hand evidence alone. Though keas are plentiful in the Tasman Valley, the guides at Mount Cook Hermitage assert without hesitation that the kea is no sheep-killer in that region. Possibly there may be parts of the Canterbury mountains where the kea has developed an appetite for mutton, but in every case the evidence should be sifted by shrewd cross-examination. Generally, New Zealand scientists consider that the charge against the kea has not been proven. On the other hand, the runholders are divided in their opinion; and whether guilty or not guilty the law decrees the kea an outlaw which may be destroyed at sight. The subject is surely one that ought to engage the attention of some unprejudiced investigator.

Mr. A. F. O'Donoghue writes in 1924 that he has collected on the kea field-observations extending over a period of ten years and embracing Westland, Marlborough, the Mount Cook district, the Mackenzie country, and that portion of the Canterbury District which lies along the upper reaches of the Waimakariri River. He says: "During the whole of this period I have missed no opportunity of questioning not only the actual station-owners, but every conceivable person with whom I came in contact, and never yet have I obtained direct evidence of the kea either hunting or attacking sheep. On my first tour through the Mackenzie country I found that the feeling on the subject was greatly divided, but as time went on and the Government and local-body subsidy increased, many converts to the cry of 'death to the kea' were made. . . . This same state of affairs obtained also in the Canterbury districts over which my observations were made."

Nor are the sheepowners themselves even yet unanimous in their condemnation of this bird. Thus Mr. A. Philpott, who himself studied the kea for several years and found no indication of its taking any notice of sheep, wrote in 1919: "The kea is common on the Hunter Mountains, where its numbers seem to be on the increase. Contrary to the experience of flockowners in other localities, Mr. H. Cuthbert, who utilizes Mounts Burns and Cleughearn, informs me that the birds have never to his knowledge interfered with his sheep."

SUMMING-UP.

The position may now be summed up as follows: From the examination of keas' stomachs there can be no doubt that these birds eat mutton. It has been proved also that dead sheep and other

carcasses are devoured by them. Finding of mutton in the stomachs is therefore no proof that the sheep were killed by the birds. There is considerable circumstantial evidence, together with direct testimony of sheepowners and shepherds, that keas attack living sheep. But the strongest proof against the kea lies in the occurrence of very peculiar wounds in the neighbourhood of the sheep's loins. Such wounds have been found only in kea-country and can hardly have been produced by any other agency than keas. It may be accepted as provisionally true that some keas do attack sheep. The previously quoted analogy with man-eating tigers is a good one, and the proportion of sheep-killing keas is apparently just as small and the individuals composing it just as abnormal. The kea is still a common bird—in fact, in spite of all measures for its extermination it has apparently increased considerably as a result of the augmentation in food-supply due to the carcasses of sheep which have died through natural causes, including possibly some which have been killed by the birds themselves. This being the case, if every or even every other kea attacked sheep to a much less extent than is often asserted sheep-farming would be no longer practicable in affected regions. There is no evidence that keas from other districts—as, for instance, scenic reserves—travel to sheep-country and there commit depredations among the flocks. It usually happens that when the local birds have been thinned or shot out the trouble ceases. The whole question of subsidies is an economic one, and has been too much obscured by unhealthy sentiment on both sides. If the progress of sheep-farming were served by the killing of the innocent along with the guilty; if the trouble among sheep were lessened by slaughtering keas where there are no sheep or where sheep are known definitely not to be molested by the birds, then ample precedent could be found for the justification of such a measure. But is such the case?

NOTE - The writer is indebted to Mr A Ironside, of the Live-stock Division, for assistance in looking up departmental records, and to Mr Harvey Drake for the accompanying photograph of the kea. Thanks are also due to the Lands Department head-office staff for assistance in referring to their files.

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FOOT-AND-MOUTH DISEASE.

C. S. M. HOPKIRK, B.V.Sc. (Melb.), Veterinary Laboratory, Wallaceville.

FOOT-AND-MOUTH disease is an acute, febrile, contagious, and infectious disease of cloven-footed animals, in the course of which an eruption of vesicles develops on the mucous membrane and the skin, especially in the mouth and in the interdigital spaces. The causative factor is an ultra-microscopic micro-organism. The disease exists in Europe, Asia, North Africa, parts of the United States, and in South American States. Australia, New Zealand, and Canada are still free from infection.

The disease attacks domesticated ruminants (cattle, sheep, and goats) and swine, but has been proved to exist rarely in deer, camels, buffaloes, wild boars, horses, dogs, and even fowls. Human children are slightly more susceptible than adults, usually dying from a gastro-intestinal catarrh. Few humans, however, are ever affected.

THE CAUSAL ORGANISM.

Loeffler and Frosch, in 1897, showed that the organism, in contradistinction to many that we know, would pass through a filter. The organism is found present in the blood generally at first, but later it becomes confined to vesicles and certain lymph-glands. According to Carrée and Vallé, secretions (except urine) are only infective if contaminated with vesicular lymph. There is no sustained proof that any other visible microscopic organism acts in conjunction with the virus. The tenacity of the virus is not of the first order. It is supposed to live in a closed glass phial in the dark for five or six months, but otherwise it is very susceptible to acidity, heating, drying, fermentation, &c. Thus it is killed in cheese or butter by acidity or pasteurization, and at a depth of about 8 in. below the surface in dung-heaps.

Dahmer and Frosch (Germany) claimed recently to have discovered the causal organism of foot-and-mouth disease by means of a special ultra photographic apparatus made by Kohler, of Java, and to have reproduced the disease from various sub-cultures of the organism. They named the latter *Loeffleria revermanni*, after two well-known scientific workers. This claim will have to be confirmed by other investigators before being definitely placed on record as correct.

PATHOGENICITY.

Direct infection: Fresh lymph introduced into the veins of cattle produces the disease lesions in one to seven days, with a dose of 1 c.c. of a suspension of 1 of lymph to 100,000 of diluting fluid. Later the udder and feet are affected. Swine-lymph is more virulent than cattle-lymph. Scarification (scratching) of mucous membranes, with introduction of virus, proves fatal. Artificially dogs and cats are susceptible. Similarly, guinea-pigs are susceptible if scarified on a surface without hair, or if injected intravenously. Rats have proved to be susceptible to injection and to intravenous inoculation, also by living in contact (Beattie, *Lancet*).

Indirect infection: This is common and important, and may be through fodder, litter, stalls, trucks, roads, pastures, markets, drinking-water, attendants' hands, clothes, boots, &c., and possibly hides, wool, manure, and milk contaminated by excretions. There is also the possibility of carriers, such as birds, and this might account for the jumps of the disease for distances of one hundred miles in a day or two. Sir Stewart Stockman and Garnett are authorities for this theory, though objections have been raised by prominent ornithologists. Beattie and Peden, in their experiments on glands from slaughtered cattle which were contact cases of foot-and-mouth disease, found vesicles on the feet and on pleural surfaces of the lungs of rats, containing a virus which seemed identical with that of the disease. Their experiments have not yet been completed. The present outbreak in England has been put down by Sir Stewart Stockman to importation of green vegetables from the Continent of Europe, and of material from the Argentine, where the disease has been particularly rife, but this has not been proved. In Switzerland experiments have proved that the disease will remain on a farm for at least six months, and it is said by Carrée and Vallé in the *Recueil de Médecine Vétérinaire* (September, 1922), that the virus remains for six weeks to eight months in pockets of the hooves of animals which have been affected. These investigators also declare that urine at the beginning of the disease is virulent, and this would appear to be a greater source of contamination of fodder, &c., than other secretions.

SYMPTOMS.

The disease commences with fever— 104° to 106° F.—more apparent in young animals than in old, accompanied by an accelerated pulse, diminished appetite, decrease in lactation, and constipation. The temperature subsides with the appearance of vesicles. Then there is, in cattle, a characteristic sucking of the lips and frequent swallowing, with later a smacking of the lips. Saliva is first frothy, then becomes ropy and mixed with shreds of epithelium hanging from the mouth. Foot lesions cause lameness through inflammation of the coronet.

In cattle, mouth lesions generally occur first, followed usually by foot lesions. In cows, udder lesions and lesions of vaginal mucous membrane may also appear. In sheep and pigs, mouth lesions are not so constant, foot lesions being more important. Other regions affected are conjunctiva, trachea, and pharynx occasionally.

The seats of mouth lesions are the tongue (body and tip) and the mucous-membrane lining of the lips and dental pad. These lesions are all vesicular in character, and quite superficial and shallow. The vesicles and ulceration vary from the size of a pea to about 1 in. in diameter. The vesicles burst in about one to three days, threads of epithelium remaining attached for a while. Finally a raw, shallow ulcer is left, which becomes deep only if a secondary bacterial invasion occurs. Healing is by simple ingrowth of epithelium from the sides of the ulceration.

Foot lesions occur at the junction of hair and hoof, and sometimes inside the hoof, especially in heel bulbs and interdigital spaces. They may cause sloughing of the hoof if secondary invasion by other bacteria occurs, or even through confluence of several large vesicles destroying the coronary bands.

Acute catarrhal gastro-enteritis often occurs in young animals, proving fatal. A malignant type may occur, chiefly in old animals, where a form of intoxication develops, showing rigors, paralysis, intestinal hæmorrhage, and finally coma and death.

COURSE OF THE DISEASE.

The disease in the majority of cases takes a favourable course of some five to six days. In mild cases two to three weeks may elapse if the various areas of infection show vesicles simultaneously. Following healing of the local lesions some animals quickly regain their former condition. In unfavourable conditions the animals may die from multiple abscess formation, septicæmia, or intoxication, the result of absorption from the secondary abscesses, &c., which may be formed. The mortality is practically nil from the disease itself, but the after-effects are those which cause so much economic loss. According to Davidson, this is particularly heavy in dairy cattle through the following factors :—

Loss of condition, which in many cases is never regained, or only with considerable expenditure in suitable foods. Winter coats may be carried through as many as three seasons without casting—a sign of a “bad doer.”

Milk-yield is greatly decreased for the remainder of the lactation period. Cows usually dry off a considerable time before next calving, and subsequent lactation periods seldom approach the old standard.

Hoof lesions often lead to arthritis, particularly in heavy animals, which have to be slaughtered. It is said that bulls are of little use for service till their hooves have sloughed off, when their vitality is often impaired.

Abortion is a common sequel, or calves at full time may be born dead or die later. Retention of the placenta is common, so bringing about sterility; and a percentage of the young stock born from affected animals prove sterile subsequently.

Mastitis, with loss of quarters, is a common result.

Dislocation of trade occurs, due to veterinary police measures.

DIAGNOSIS AND TREATMENT.

A diagnosis of the disease can be made by the presence of fever and constitutional disturbance, followed by foot or mouth lesions, or both, causing a shallow ulceration. Rapid contagion and simultaneous affection of cattle, sheep, and pigs are factors of great use in diagnosis. In a newly infected country inoculation experiments from one animal to another might be required for confirmation.

Treatment would be impossible in a new country such as New Zealand, nor is it possible in England, where the disease is not always present. Slaughter of all contacts is advisable, and State policy generally provides for compensation for animals compulsorily slaughtered. In older countries local lesions are treated, and in Hong Kong a treatment which had some beneficial result was the intravenous injection of trypan blue for its destructive action on the organism, although harmless to body cells.

PREVENTION.

On the Continent of Europe much work has been done with a view to immunization, but this has not proved effective. Natural immunity following an attack of the disease exists for no longer than twelve months, and even during that period there is no very active immunity. Active immunization with small quantities of active virus from vesicles has not been satisfactory. Passive immunization with large quantities of serum has protected for periods of three weeks, but this method is too expensive for general use in an outbreak. In some parts emergency vaccination is practised so that the disease may be disseminated through the herd at one time, instead of lingering on for weeks. This is only done where the disease is of mild character, not in virulent outbreaks where many deaths occur. It is possible in an outbreak to keep a temperature chart of cattle, and by immediate segregation of animals showing a rise confine the outbreak to a few in the one shed, so preventing a large outbreak.

In Great Britain in the event of an outbreak the regulations provide that notification must be made at once to the Government veterinary officer; that all animal contacts and infected cattle, sheep, and pigs must be slaughtered, either on the farm or in a defined area; that all traffic be suspended at once, the farm itself remaining in strict quarantine for animals; that premises, roads, trucks, &c., over which cattle may have travelled be thoroughly disinfected. In Switzerland persons are also included in this quarantine, which is a very sane procedure.

If the disease is to be kept out of countries not affected, quarantine measures have to be enforced against any other country in which the disease is prevalent, in the matter of importation of stock, hay or straw, packing-material, and animal products such as cow-pox lymph, &c. Quarantine of animals for periods is unsafe for at least six months after the last declaration of the disease in the country affected. In cattle certain animals, according to Loeffler, have been found to be carriers up to a period of seven months.

No successful experiments have been conducted to show the length of time that foot-and-mouth virus will remain on straw under ideal conditions, such as darkness, sufficient moisture, and correct temperature. But, as the organism is so easily killed through desiccation, &c., it does not seem probable that it would last a sufficient length of time to reach New Zealand other than on an infected beast. The greater possibility appears, in the light of late experiments, to be through a rat-infestation of the ship. To be quite on the safe side, however, and until more is known of the carriage of this dreaded disease, it would be necessary to prohibit the entry of any material that might possibly have been in contact with excretions from affected stock.

Perennial Rye-grass Germination.—In the record of operations of the official seed-testing station published in last month's *Journal* it was mentioned that Southern, Canterbury, and Sandon seed for 1924 had shown a distinct improvement on that for 1923. It is of interest to record that the average germination figures of the new harvest for each season are as follows: 1923 — Southern, 77·8 per cent.; Canterbury, 82·3; Sandon, 76·5. 1924 — Southern, 88·9; Canterbury, 93·8; Sandon, 84·3 per cent.

TOMATO-CULTURE.

SOME FURTHER NOTES ON DISEASE-CONTROL.

W. H. TAYLOR (late Horticulturist), Wellington.

WERE it not for the frequency of the occurrence of diseases of various kinds, and the virulence of their attack, the tomato would be about the easiest to grow of all the more important horticultural crops. How far these diseases are avoidable is a most important question, and the means by which they may be avoided is a problem that concerns all tomato-growers. Identification of the various diseases is of little value unless it indicates a line of treatment. How to avoid attacks or to control them when they occur is the thing that matters. The problem must be approached with an unbiased mind if real good is to be done. One must be prepared to find former ideas and practice were wrong, and not to mind it, provided the truth emerges.

In a periodical of the International Institute of Agriculture, about ten years ago, the statement was made that "there is no disease which is inherent in the tomato; every disease from which it suffers is the result of errors in cultivation." This is a plain statement that a good many are sure to dispute, yet evidence is accumulating to prove it right. Those whose memory can carry them back about thirty-five years will remember the first occurrence of tomato-disease in this country. Prior to that time there was no disease; the plants bore abundant crops of quite clean fruit. Diseases began to appear about the time stated; what they were is of little moment, and it is doubtful if any one knew. It is only within the last three or four years that the black-stripe disease has been identified, yet it has been with us for at least thirty years. The organism is now defined as *Bacillus Lathyri*, the same as that responsible for the stripe disease of sweet-peas and for wholesale losses of asters.

The writer is now obliged to refer to personal experience; it is the only experience available to him proving wrong practice to be responsible for outbreaks of disease. He has grown tomatoes every year for forty-five years in the open ground, and for a number of years in a small way under glass. When attacks first occurred it was on plants growing on land to which stable manure had been freshly applied. Plants on ground manured the previous year and that had produced other crops were not affected.* Noticing this, the same practice was followed in after-years, and the same thing occurred. Except in abnormally dry seasons there was no blight until autumn rains fell; then the freshly manured patches were blighted — not the others. These experiments were carried on for ten years, which was considered sufficient for the purpose. Since that time freshly manured ground has never been used by the writer, nor any nitrogenous fertilizers, and blights have never again appeared on his plants. For nine years during which tomatoes were grown in some quantity at the Weraroa State Farm there was

* This safety depends on a moderate amount of manure being used, and a strong-growing prior crop, such as cabbages, being grown. Overmanured land may produce black-stripe disease for several seasons.

no appearance of blight, yet the district is one specially liable to it. It was while at Weraroa—about fifteen years ago—that the writer first recommended this system in the Department's publications, and the same system is advised in Bulletin No. 71, "Tomato-culture," issued in 1918.

BLACK-STRIPE.

It was not until four years ago that the writer fully experienced the value of potash in combating tomato-diseases. Being called upon to advise treatment for black-stripe, which was killing plants wholesale in a large tomato-house, and considering that the strong growth and deep green of the foliage indicated too much nitrogen, also knowing that potash in sufficient quantity will arrest growth, applications of sulphate of potash were advised. The advice was acted on, and the plants were saved, the house giving the best returns in the district. In recent years it has been proved that great losses have occurred where stable manure has been liberally applied, and that sulphate of potash used in large quantities can save the plants even in such cases. It may be mentioned here that spraying has no effect on black-stripe.

The first information about black-stripe from overseas was found in the *Canadian Horticulturist* for April, 1922, in a report by Dr. R. E. Stone, Guelph. The next information received was in a paper on tomato-diseases by Dr. W. Bewley, Director of the Lea Valley Experimental and Research Station, Cheshunt, England. This report may be said to have been identical in its findings with that of Dr. Stone, but added to it by defining the disease as *Bacillus Lathyri*. Both these reports confirmed the views of the present writer (and promulgated by the Department) regarding stable manure and nitrogenous fertilizers in relation to tomato-culture. Space restrictions preclude quotations here, but full extracts were given in an article on tomato-diseases published in this *Journal* for February, 1923.

SLEEPING-DISEASE.

Until recent years sleeping-disease of tomatoes was held to be caused by the fungus *Fusarium Lycopersici*. It is now held that the chief infection is caused by *Verticillium albo-atrum*. Specimens have been so identified at the Department's Biological Laboratory, and there is little cause to doubt that this is the chief sleeping-disease in New Zealand. It is important that the right identification be made, for, according to the English report previously referred to, the organisms occur in opposite conditions—*Verticillium* with low temperatures and *Fusarium* with high temperatures. Thus it is stated that *Verticillium* is distinctly correlated to early planting, and the best means of control are to delay planting to a date later than has been normal. This is quite in accordance with experience here; plants set out at the correct time, but which many consider late, are rarely affected by sleeping-disease. In this connection it should be understood that the trouble does not always show as an early infection; it may not appear till a cold spell occurs, when the disease, which has lain latent, makes rapid development. It has been found that wilted plants in a glasshouse may be saved by raising the average temperature to 77° F., and shading the glass lightly with whiting.

TOMATO-MILDEW (CLADOSPORIUM FULVUM).

This is the disease known here as tomato-mould or tomato-rust. It is a fungus that attacks the leaves, and in bad cases quickly spreads over the whole of the foliage and causes the death of the plants. It is essentially a glasshouse disease. The cause is insufficient ventilation, together with a high temperature and a saturated atmosphere. Dusting with dry sulphur and spraying with potassium sulphide have both been found useful, but the chief means of control is increased ventilation. Drastic measures must be taken; after the first fruits are gathered the old leaves must be taken off up to the fourth joint and growths thinned out.

BLOSSOM-END ROT.

Of this trouble Dr. Bewley says it is universally found in tomato-growing areas. Plants that are growing rapidly are most susceptible, and either continued excessive watering or a sudden check in the water-supply may produce the disease. The latter condition appears to be the most common cause (this refers to England, where tomatoes are mostly grown in glasshouses), and careful attention to the conservation of the correct amount of water in the soil has generally been successful in preventing trouble.

"DAMPING OFF" AND "FOOT-ROT."

In the *Journal of the Ministry of Agriculture* for October, 1921, was published an informative article by Dr. Bewley on the control of "damping off" and "foot-rot" caused by *Phytophthora parasitica*, *P. cryptoglia*, and *Rhizoctonia solani* in England. It is not certain whether all these diseases have been found in New Zealand, but rhizoctonia has certainly been identified at the Department's Biological Laboratory. Following is a summary of the article, published by the International Institute of Agriculture :—

Sterilization of soil, seed-boxes, and pots by means of heat or formaldehyde has previously been proposed as adequate methods for control of the serious diseases of tomatoes known as "damping off" and "foot-rot." These methods, however, do not suit many growers, and as a result another remedy has been put forward which has been named "Cheshunt Compound," investigations relative to this having been made at the Experimental and Research Station, Cheshunt.

This compound contains 2 oz. of copper sulphate and 11 oz. of ammonium carbonate, reduced to a fine powder and thoroughly mixed. The mixture may be stored in a dry state in an airtight receptacle, without which it gradually loses ammonia and becomes less potent. The dry mixture should be stored for twenty-four hours in a tightly corked glass or stone jar before using. The solution is then prepared by dissolving 1 oz. in a little hot water and making up to 2 gallons with water. The solution must not be put in vessels of iron, tin, or zinc, as it would corrode them and lose its strength. Only just as much as is required for immediate use should be prepared.

Plants already attacked receive no benefit from the solution and eventually die, unless the tops are cut off above the diseased part and treated as cuttings. It is possible, however, to kill the causal organism by watering infected soil with the solution, after which immediate planting may follow without harming the plants. It is possible also to treat infected soil with the plants *in situ*. The solution destroys the disease organisms and at the same time increases the vigour of the plants.

When the soil is suspected of being infected the following methods should be adopted :—

(a.) **Seed-boxes :** The soil should be thoroughly watered with the solution after sowing and covering the seeds. Generally 1 pint per box (14 in. by 9 in. by 2 in.) is sufficient.

(b.) **Pots :** The young seedlings should be planted and watered with the solution immediately afterwards. To enable each plant to get sufficient solution, the level of the soil should be 1 in. below the top of the pot. If left overnight before treatment many plants become infected and the treatment is rendered useless.

(c.) **Houses :** Each plant should be removed when attacked, the hole watered with 1 pint of the solution, a healthy plant inserted, and watering with the solution repeated.

This solution has a beneficial effect in the case of many seedlings attacked by "damping off" besides the tomato. In the case of delicate seedlings, however, it is necessary for the solution to be more diluted. Preliminary experiment with the compound upon other root-diseases has given satisfactory results.

It may be mentioned that the current price for ammonium carbonate from wholesale druggists in New Zealand is 1s. 3d. per pound for small quantities.

PREPARATION OF SOIL FOR DISEASE-CONTROL.

The *Australasian Nurseryman and Seedsman* for December, 1922, in an article referring to "spotted wilt" (a serious disease not known to be in New Zealand) and rhizoctonia quotes Mr. Brittlebank, Plant Pathologist to the Victorian Government, who speaks of rhizoctonia as a most destructive disease that is widespread in Australia. He recommends special preparation of soil for seed-boxes as a means of control. The soil, he says, should be prepared fully a year before it is used, being mixed with lime and turned from time to time. The present writer may add to this that the soil should not be allowed to grow weeds. It should be turned often enough to prevent much growth, and the top hoed over now and again. Some growers raise their plants in glasshouses, in half benzine-tins. The soil for this purpose is prepared by growing green crops on a selected plot. Several crops are grown and turned in as they are ready, manure being given to ensure good growth and to enrich the soil. The soil is thus prepared during the summer and taken for use in autumn or early spring. It would be better if it were prepared a year before, keeping it stacked and clean as described. A season of clean fallow doubtless largely rids the soil of diseases; for example, experiments have shown that one year's clean fallow does as much good against eelworm as the most successful chemical treatment. Some of our most experienced growers prepare their box soil a year and even more in advance, being fully aware of the value of clean material and the benefit it derives from full exposure to sun and air. Others stack their soil in good time, but neglect to keep weeds down, which latter is all-important.

Bottling of Cider.—In the article on cider-making published in the *Journal* for April last (page 249) it was inadvertently stated that the corks should be boiled before use. The correct practice is to steep the corks in warm water—not boil them.

DODDER IN WHITE CLOVER.

NEW MAGNETIC PROCESS OF REMOVAL.

NELSON R. FOY, Seed Analyst, Biological Laboratory, Wellington.

IN the report of the English official seed-testing station for 1922-23 the following statement is made regarding white clover: "New Zealand seed shows the highest purity and germination. It is unfortunate, however, that more attention is not paid to the removal of the small-seeded dodder."

While the sale of white clover containing dodder is not prohibited in England, the dodder-content of such seed has to be declared if the seed is offered for sale. The presence of dodder must therefore greatly depress the price. In some other countries to which New Zealand exports white-clover seed the import regulations are not so lenient; Australia will not allow the entry of a line even if it contains only one seed of dodder per pound—it must be "dodder-free." The United States allows only one seed in 5 grams, which is at the rate of approximately ninety seeds per pound. In Canada the Seed Control Act operates in a similar manner to that of England.

It is evident, therefore, that for an overseas trade to be successfully carried on New Zealand white-clover seed must be free from dodder. According to the purity examination made at our station only 5 per cent. of the samples examined contained dodder. It must be borne in mind, however, that a 1 oz. or 2 oz. sample will not always reveal the presence of dodder in a large line. Recently two 1 oz. samples of a line were passed as dodder-free, but a later examination of an 8 oz. sample revealed the presence of dodder. Further, only a portion of the white-clover samples received are analysed for purity, and a large number of samples which are tested for germination only will probably contain dodder.

Small-seeded dodder (*Cuscuta trifolii*) in white clover has always given the seed-cleaner trouble, as its size prevents it being totally dressed out. In cow-grass its removal presents no difficulty. In white clover a great deal is removed by means of screens and the velvet linings of the Dosser machine, but there always remain the few seeds in sufficient quantity to give trouble. The introduction of a new electro-magnetic process for dodder-extraction is therefore of interest and importance. The method, like that of the Dosser machine, is based on the fact that dodder possesses a much rougher and less polished seed-coat than does the white clover. The seed is mixed with a powder which is sensitive to a magnet, and more of this powder adheres to the rough surface of the dodder-seeds than to the smooth coat of the clover. The seed is then passed under a magnet, which draws out the seeds bearing sufficient of the powder to be magnetically attracted. By this means the dodder may be absolutely eliminated, and, in addition, such seeds as rough-coated sorrel and broken clover-seeds whose rough surfaces hold the powder would be removed. After the magnetic treatment the clover is passed through a polisher to remove any adhering powder.

Mr. C. B. Saunders, late chief officer of the English seed-testing station, stated recently in the *Journal of the Ministry of Agriculture*: "The first commercial machine working on the principle outlined has been in use for six months, and has given remarkably good results, a single treatment removing every seed of dodder from a bulk of Chilian red clover. Apart from its efficiency for removing dodder the importance of the process lies in the very small wastage. The machine has dealt with over 50 tons of seed, and the total cleanings are not much more than half a ton, so that it follows that the amount of good seed removed is negligible."

Such a machine should amply pay for itself in New Zealand, as it would enable the removal of all dodder from any clover or Lotus seed. Further particulars can be given by the writer to any of those specially interested.

TESTING OF PUREBRED DAIRY COWS.

JANUARY-JUNE CERTIFICATE-OF-RECORD LIST.

W. M. SINGLETON, Director of the Dairy Division.

THE appended list of cows which received certificates during the six months ended 30th June, 1924, comprises more names than that for any similar period since the C.O.R. testing system was initiated. This naturally is accounted for to some extent by the general increase in the total number of cows under C.O.R. test, but more particularly by the fact that, as time goes on, breeders seem to adhere less strictly to the common practice of having cows freshen in the spring. There are many dairymen who are of the opinion that it is advantageous to have their cows calve in the autumn. They maintain that autumn calvers coming in in good condition after a rest during the late summer are better able to stand the winter. They get the benefit of the spring just when the body begins to feel the effects of renewed pregnancy, and thus a falling-off in milk-flow is postponed. Thus, while the spring still brings its rush, the C.O.R. testing is each year becoming more evenly distributed throughout the twelve months. Concerning this point the following figures are of interest:—

Month	Number of Cows on Test	Month	Number of Cows on Test.
1923.		1924.	
July	925	January	1,164
August	970	February	1,165
September	1,089	March	1,161
October	1,163	April	1,129
November	1,185	May	1,107
December	1,173	June	1,037

From this table, presenting the number of cows on test month by month during the past year, it will be seen that while November shows the flush, the other months do not indicate the falling-off which might be expected.

NOTES ON THE LEADING RECORDS.

Jerseys.

The highest Jersey performance is that of Grafton Marigold, tested by Messrs. Brakenridge and Pearson, of Taupaki. This mature cow produced 734·23 lb. of butterfat, which for her owners should be an encouraging result of a first season's experience of C.O.R. testing. Her pedigree contains the names of many proven animals, and also strains which, though perhaps not proven through test of the individual itself, are nevertheless recognized through the performances of progeny. The grandsire on the sire's side is Golden Swan. On the same half of the pedigree appear such names as K.C.B. and some of the Sunflowers. The dam of Grafton Marigold is Pepper's Girl, a daughter of Pepper (546·01 butterfat at 3 years 195 days in the first year of the C.O.R. system). K.C.B. also appears on this side of the pedigree. It is therefore a more or less reasonable expectation that Grafton Marigold should yield creditably.

Friesians.

The outstanding butterfat yield for this breed is credited to Mr. James Hart's Lady Pauline, who has gained a certificate on a production of 850·66 lb. butterfat. This cow has previously figured in our records, when as a junior two-year-old she qualified on the yield of 603·85 lb. butterfat. She is sired by Prince Pietertje of Cliffside, who is also the sire of Princess Gem (794·84 lb. butterfat), and of Lady Fayne, who produced 498·66 lb. butterfat as a senior two-year-old. Prince Pietertje of Cliffside is in turn sired by Cliffside Laddie, whose name requires no comment. Lady Pauline's dam is the imported Johanna Fayne Lady, who has gained two certificates of record in New Zealand—one for 325·95 lb. and another for 532·38 lb. butterfat, each at an age under maturity.

Milking Shorthorns.

Matangi Quality 4th, owned by Messrs. Ranstead Bros., heads the section for the Milking Shorthorns. She is a junior three-year-old and has placed 678·02 lb. butterfat to her credit, thus exceeding the record of the previous leader of this class—Dominion Carnation of Ruakura—by no less than 238·82 lb. Matangi Quality 4th is a daughter of Dominion Esau of Ruakura. It is interesting to note that of the seven classes into which the Milking Shorthorn breed is subdivided five of the class-leaderships are held by animals owned by Messrs. Ranstead Bros., and that each leader, with the exception of Maniaroa Princess, the mature-class champion, is a daughter of Dominion Esau of Ruakura.

Ayrshires.

Only two Ayrshires appear in the list, but Mr. E. J. Irving's Queen Mary has produced very creditably with 573·65 lb. butterfat. She is by Lessnessock Grandeur from Sunbeam 2nd of Inglewood.

LIST OF RECORDS, JANUARY TO JUNE, 1924, INCLUSIVE.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days	Milk.	Fat.

JERSEYS.						
		Yrs. dys.	lb.		lb.	lb.
<i>Junior Two-year-old.</i>						
Violona	Farrow Bros., Wairoa ..	1 302	240·5	326	10,435·2	575·90
Waionui Flirt ..	W. H. Miers, Rukuhia ..	2 87	249·2	365	9,245·7	548·88
Clever Mary ..	J. Perham, Waipuku ..	1 303	240·5	365	8,362·2	468·36
Tillingdown Constance	Dr. H. Washbourne, Richmond	2 34	243·9	365	7,915·7	468·30
Hopeful Choice ..	W. T. Williams, Pukehou ..	2 85	249·0	365	7,608·5	459·05
Grafton Mint ..	A. A. White, Auckland ..	2 29	243·4	365	8,586·0	427·65
Alfalfa Senora ..	F. J. Saxby, Hamilton ..	1 211	240·5	365	7,394·8	425·47
Snowview's Lenora ..	A. E. Watkin, Takanini ..	1 307	240·5	365	6,783·8	411·82
Pet Irenet ..	C. Stevens, Maungatapere ..	2 39	244·4	365	7,514·4	408·38
Illawarra Beautiful	E. G. Jones, Midhurst ..	1 229	240·5	365	6,303·0	376·05
Jerseydale Fairy ..	J. Pettigrew, Pihama ..	2 23	242·8	365	7,142·5	360·72
Marama Glory ..	R. S. Coplestone, Eltham ..	1 301	240·5	365	7,736·6	369·55
Corra Lynn Rosebud	A. Best, Bombay ..	2 31	243·6	365	6,928·6	367·61
Silverley's Autumn Rose	R. C. Jury, Tikorangi ..	1 261	240·5	365	5,791·5	349·77
Ratanui Magnet ..	R. S. Coplestone, Eltham ..	2 50	245·5	334	7,447·7	349·62
Loe's Majesty ..	A. Christie, Tanekaha ..	1 303	240·5	212	6,057·2	329·35
Creehton Lady Koura	C. Brock, Eltham ..	1 354	240·5	245	5,284·9	301·75
Bridge View Myrtle ..	A. L. Hooper, Mahoe ..	2 27	243·2	198	4,523·1	259·35
Wee Lark ..	R. Hicks, Hawera ..	2 34	243·9	181	5,496·2	257·02
<i>Senior Two-year-old.</i>						
Ratanui Marionette ..	W. T. Williams, Pukehou ..	2 107	251·2	365	12,659·7	588·72
Hurden Goldfish ..	G. E. Cowling, Manaia ..	2 137	254·2	365	6,521·7	385·40
Trewithen's Sylvia ..	J. Klenner, Kaimata ..	2 355	276·0	327	6,530·7	383·54
Signor's Whitefoot ..	G. Buchanan, Paeroa ..	2 204	260·9	332	5,700·0	326·00
Pretty Sweetheart ..	H. C. Sampson, Hillsborough	2 221	262·6	334	4,621·0	263·94
<i>Three-year-old</i>						
Viola's Frisky ..	A. L. Hooper, Mahoe ..	3 79	284·9	365	10,502·8	646·14
Holly Oak's Tiny ..	Dr. H. P. Pickerill, Kelso ..	3 66	283·6	365	9,536·8	545·10
Pettie's Charm ..	R. S. Coplestone, Eltham ..	3 253	302·5	364	8,098·2	512·47
Princess Eleanor ..	R. J. W. Hancock, Waitara ..	3 283	305·3	310	8,498·2	480·43
Jersey Brae's Oaks ..	F. J. B. Ryburn, Paterangi ..	3 333	310·3	282	8,903·6	442·01
Bridge View Tiny ..	G. A. Gamman, Marton ..	3 268	303·8	295	7,932·5	441·17
<i>Four-year-old.</i>						
Heywood's Ethel ..	J. McIvor, Ohaupo ..	4 335	347·0	366	9,866·1	581·61
Royal Jenney's Lady	T. H. Verry, Pahiatua ..	4 54	318·9	365	10,062·7	570·36
Kathleen Mahone ..	H. Doel, Taumarere ..	4 137	327·2	365	8,339·9	482·36
Riverina Peep Bo ..	H. W. Nicholls, Belgrove ..	4 88	322·3	365	9,466·3	462·14
Climax ..	W. McGowan, Papatoetoe ..	4 193	332·8	344	7,111·3	357·11
<i>Mature.</i>						
Grafton Marigold ..	Brakenridge and Pearson, Taupaki	6 257	350·0	365	13,626·0	734·23
Agatha ..	C. Stevens, Maungatapere ..	9 23	350·0	365	12,421·7	655·84
Cream of O.K. ..	T. Linn, Mangatoki ..	6 327	350·0	365	11,257·5	649·36
Beachland's Marguerite	Moreland and Son, Te Rapa	5 40	350·0	365	10,674·9	599·69
Briar Chase ..	W. J. Hall, Matatoki ..	5 75	350·0	365	10,207·9	586·77
Mountain View's Sunflower	W. J. Hall, Matatoki ..	7 191	350·0	365	10,453·5	563·45
Linnett ..	C. G. C. Dermer, Waipiko ..	11 127	350·0	365	13,041·2	530·82



WAIPIKO JOLLY (C. G. C. DERMER, WAIPIKO).

C.O.R., 1923, in Jersey junior two-year-old class: 11,512·9 lb. milk, 610·40 lb. butterfat.



ASHLYN BLATUS (FIRI LAND COMPANY, AUCKLAND).

C.O.R., 1923, in Friesian mature class: 15,359·7 lb. milk, 751·79 lb. butterfat.

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS—*continued.*

		Yrs. dys	lb.		lb.	lb
<i>Mature—continued.</i>						
Collingwood Ruby ..	Hellyer Estate, Dunedin ..	6 134	350·0	365	9,572·9	515·39
Katie of St. Lambert's Queen	H B. Lepper, Lepperton ..	9 4	350·0	365	9,437·2	513·75
Silverdale Primrose ..	G. Hodgson, Whakapara ..	5 79	350·0	365	8,139·1	482·15
Antelope ..	K. M. Stevens, Maungatapere ..	8 6	350·0	365	10,045·5	477·07
Paratawhiti Prim ..	G. E. Cowling, Manaia ..	7 286	350·0	360	9,301·0	476·64
Pride of Tumanako ..	G. A. Gamman, Marton ..	6 105	350·0	355	9,559·2	470·02
Sweet Mabel of O.K.	R. Dunn, Auroa ..	7 27	350·0	240	7,807·1	467·11
Darkie of Ascot ..	Miss Y. Southey-Baker, Te Rapa	5 236	350·0	365	8,096·6	464·65
Calabria ..	C. Stevens, Maungatapere ..	6 32	350·0	365	8,262·5	450·32
Cruiskeen† ..	C. Stevens, Maungatapere ..	6 120	350·0	365	7,641·2	415·57
Belmont Jersey ..	C. B. Herrold, Waiuku ..	5 323	350·0	359	6,425·3	414·31
Flower of Collingwood	Hellyer Estate, Dunedin ..	7 263	350·0	296	9,025·8	403·84

FRIESIANS.

<i>Junior Two-year-old</i>						
Springtime of Oakview 3rd*	H. R. Green, Kairanga ..	2 37	244·2	305	17,192·4	652·61
Glenmore Tilly Alcartra*	Henry Johnston, Stratford	2 27	243·5	365	14,595·5	495·05
Skylark Alcartra† ..	S. Andrew, Kaikoura ..	2 92	249·7	305	14,809·5	470·63
Netherland Princess Lady*	W. I. Lovelock, Palmerston North	2 31	243·6	365	12,219·5	399·46
Welfare Alcartra† ..	S. Andrew, Kaikoura ..	2 30	243·5	365	10,986·2	388·44
Anawhata Tirania De Kol†	P. F. Boucher, Kumeu ..	2 146	255·1	365	10,365·0	365·03
Zealous Alcartra† ..	S. Andrew, Kaikoura ..	2 17	242·2	365	10,011·8	364·17
Dale Ida* ..	R. C. Allen, Piako ..	2 25	243·0	355	9,735·5	359·68
Friesian Cadillac Princess*	W. I. Lovelock, Palmerston North	2 43	244·8	310	9,464·1	347·38
Playgoer Alcartra† ..	S. Andrew, Kaikoura ..	1 347	240·5	365	9,423·5	320·91
<i>Senior Two-year-old</i>						
Cordylina Daisy Bud†	G. Aitchison, Kaitangata ..	2 187	259·2	364	11,575·0	470·47
Ashlynn 86th† ..	Piri Land Company, Taupiri	2 298	270·3	342	10,873·6	385·13
Ashlynn 89th† ..	Piri Land Company, Taupiri	2 282	268·7	329	12,109·4	382·40
<i>Junior Three-year-old</i>						
Abbe Queen Segis* ..	J. McNulty, Ashburton ..	3 101	287·1	365	15,996·9	573·13
Bloomfield Netherland May*	Bloomfield Farm Company, Wellington	3 48	281·8	365	13,157·8	553·33
Isabella Abbekerk 2nd†	Voss Bros., Longburn ..	3 87	285·7	365	12,085·3	468·72
Ryvington Thorat† ..	Hodgson Estate, Tamahere	3 117	288·7	365	11,397·2	445·19
Cordylina Canary De Kol†	G. Aitchison, Kaitangata ..	3 182	295·2	348	11,376·5	436·53
<i>Senior Three-year-old.</i>						
Galatea Queen* ..	C. W. Baldwin and Son, Ngatoro	3 270	304·0	308	15,971·3	524·00
Countess Belle Segis†	P. F. Boucher, Kumeu ..	3 314	308·4	362	10,520·4	382·43
Cluny Annette 7th† ..	W. H. Madill, Auckland ..	3 192	296·2	329	9,837·4	357·82
<i>Junior Four-year-old.</i>						
Ryvington Quick† ..	Hodgson Estate, Tamahere	4 101	323·6	365	14,529·8	626·08
Princess Pontiac De Kol†	A. Burgess, Rongotea ..	4 64	319·9	365	16,269·8	529·74

LIST OF RECORDS—continued.

Name of Cow and Class	Tested by	Age at Start of Test.	Fatred for Cwt	Yield for Season		
				Days.	Milk.	Fat.

FRIESIANS—continued.

<i>Mature.</i>		Yrs. dys.	lb		lb.	lb.
Lady Pauline* ..	J. Hart, Tatuani, Thames	7 2 34	350·0	305	25,300·2	850·66
Emily Mercedes Grant*	Bloomfield Farm Company, Wellington	10 262	350·0	305	19,206·3	631·16
Lillith Mercedes of Hawkridge*	R. Colee, Greendale ..	5 01	350·0	305	18,077·8	543·55
Laddie's Pearl† ..	N. P. Neilson, Tiakitahuna	12 49	350·0	365	14,066·8	410·97

MILKING SHORTHORNS

<i>Junior Three-year-old.</i>						
Matangi Quality IV†	Ranstead Bros, Matangi ..	3 153	292·1	305	16,281·4	678·02

Mature.

Otaua Peggy† ..	S. Lye, Newstead ..	.	350·0	354	12,485·4	476·16
Duchess of Clydesdale 2nd	Robert Peach, Ashley Bank	7 340	350·0	353	10,605·3	425·78
Daisy 4th ..	Robert Peach, Ashley Bank	7 57	350·0	335	10,246·0	368·60

AYRSHIRES.

<i>Mature</i>						
Queen Mary* ..	E. J. Irving, Ryal Bush ..	5 347	350·0	305	14,700·0	573·65
Wee Nancy of Edendale	W. Hall, Lepperton ..	12 100	350·0	305	11,452·8	467·22

SECOND-CLASS CERTIFICATES.

JERSEYS

<i>Junior Two-year-old</i>						
Waionui Fortunate ..	A. J. Dempsey, Horsham Downs	2 66	247·1	365	8,174·3	475·07
Adare Sunbeam ..	J. A. Kurth and Son, New Plymouth	1 219	240·5	365	6,780·2	412·33
Grafton Pepper ..	A. A. White, Auckland ..	1 286	240·5	365	8,168·5	390·32
<i>Senior Two-year-old</i>						
Regal Patricia ..	C. Stevens, Maungatapere ..	2 135	254·0	365	7,058·7	383·47
<i>Three-year-old</i>						
Rainbow's Interlude ..	H. George, Kaupokonui ..	3 303	307·3	365	7,581·6	465·56
<i>Mature.</i>						
Twylsh's Darkie ..	F. J. Saxby, Hamilton ..	5 364	350·0	365	13,193·4	808·78
Lucky Dorothy Cactus	C. Stevens, Maungatapere ..	5 94	350·0	365	12,110·3	653·70
Lady Briar ..	H. C. Sampson, Hillsborough	8 78	350·0	365	10,081·8	569·52

FRIESIANS

<i>Junior Two-year-old.</i>						
Brookfield Nobeltje Pride	Piri Land Company, Taupiri	1 323	240·5	365	13,068·0	477·39
Pakeha Alcartra ..	S. Andrew, Kaikoura ..	1 331	240·5	365	12,077·7	411·49
<i>Junior Four-year-old.</i>						
Rosevale Isobel ..	North and Sons, Omimi ..	4 119	325·4	365	20,122·6	643·11
<i>Mature.</i>						
Riverdale Cherry Blossom	S. Clements, Rototuna ..	7 44	350·0	365	13,031·9	461·82
Cordylne Cherry Ripe	R. J. Potter, Pukerau ..	6 190	350·0	195	10,206·9	363·54

SEASONAL NOTES.

THE FARM.

CARE OF PASTURES.

AUGUST often brings quite an appreciable amount of pasture-growth, at any rate in the milder districts, and where roots and other winter fodder are running short this early bite is very welcome. The stock, too, will at this time of year relish the slenderest picking of fresh grass, and in these circumstances it is always a temptation to allow them to feed closely all they can find. Crops of a purely temporary nature, such as Western Wolths or Italian rye-grass, green oats, &c., can be so treated, while an old turf carrying a certain amount of rough feed is often benefited; but young permanent grass, and even old grass where it has a tendency to become bare at the roots, may suffer considerably at this time by the overgrazing and poaching of stock. The farmer who can save his permanent grass by utilizing catch-crops, or by feeding out mangolds or ensilage on dry, well-turfed paddocks, will reap the benefit later in the season.

Top-dressing of pastures should be completed in August. In the wetter districts slag may be put on up to the middle of the month, but in drier regions and on light soils spring manuring should consist mainly of super or basic super, at the rate of about 2 cwt. per acre. It is often a good plan to leave one or two untreated strips across the paddock. Observation of the grazing of stock and the growth of the grasses may lead to some special ideas being gained of the value of top-dressing on the respective area. Occupiers of land with a tendency to revert to fern will find that stock graze much more keenly where phosphatic fertilizers have been used, the manure-bag thus being an excellent weapon against such secondary growth as well as against the smaller weeds. The harrows should be kept going to distribute the droppings of stock.

SPRING CULTIVATION.

August being the beginning of the busy season in cultural operations, the team should be kept going when weather and soil conditions permit, but on no account should attempts be made to work land while in a waterlogged condition. Generally speaking, this refers to land previously ploughed during late autumn or winter which has absorbed and retained the seasonal rains. On the other hand, grassland may be ploughed a first time while fairly moist. In the drier districts, such as North Otago, Canterbury, and Marlborough, deep ploughing of land in preparation for spring-sown crops should, as a rule, not be undertaken after August, otherwise the operation will result in a loosening of the soil to too great a depth and consequent undue loss of moisture.

Land intended for roots or green fodders, main-crop potatoes, &c., should be taken in hand and kept stirred occasionally from now on till sowing-time, with the object of germinating and killing as

many weed-seeds as possible. The great object should be to have a fine mellow, well-aerated seed-bed. Lea land previously skim-ploughed should be cross-ploughed as soon as dry enough, in order that a reasonable fallow may result.

CEREAL CROPS FOR GRAIN OR CHAFF.

Weather permitting, spring wheat, oats, and barley should be got in during August in Canterbury, North Otago, and Marlborough. In South Otago, Southland, and the North Island early September is generally soon enough for oats and wheat, and towards the end of that month for barley. Seed should be treated for smut with formalin or bluestone solution according to details given in these notes in the *Journal* for April last. Heavier seeding is necessary for spring-sown wheat—say, from $2\frac{1}{2}$ to $2\frac{3}{4}$ bushels per acre, while 1 cwt. to $1\frac{1}{2}$ cwt. of super is advisable. One or more of the quick-maturing and hardy varieties should be chosen. With oats, especially when required only for chaff, the preference lies with Algerian as the most rust-resistant variety.

Autumn-sown cereal crops should be harrowed in order to break any crust which may have been caused by winter rains. The resulting soil-mulch will dry quickly and leave the surface in loose condition such as to prevent the moisture rising from below reaching the surface and so being lost by evaporation. Where the ground is lumpy a rolling will break down the clods and pack the lower soil more thoroughly. Such rolling should always be followed by a stroke of the harrows. If the crop has not been previously manured and appears thin or weak 1 cwt. of super per acre, either before or after harrowing, will be beneficial. A little cow-grass—say, 3 lb. or 4 lb. per acre—sown on the crop at this time should prove profitable, providing a fresh bite for stock after harvest while the stubbles are being cleaned up, and later to be ploughed in.

Feeding off of autumn-sown cereals should be done before the crops become too rank, and, generally, two light feedings will be better for the crop and the stock than one heavy feeding. If the land is inclined to be still wet, stock should be kept off, or excessive caking of the ground will result.

The practice of spring sowing a pasture mixture on autumn-sown cereals is much in favour in some South Island localities. If the cereal crop has not already been manured a dressing of about 1 cwt. per acre of super or basic super or Ephos phosphate will generally be an advantage.

LUCERNE AND CLOVER STANDS FOR SEED.

August is a good month for the cultivation of lucerne and red-clover stands intended for seed. The tine harrows or a cultivator with special lucerne points are generally used. The disks, moderately used with a straight cut, often prove beneficial to a stand which has been established for two years or longer. The yield of seed from both red-clover and lucerne stands will normally be much increased by top-dressing with one or other of the following manurial mixtures: (1) 1 cwt. super, following 1 ton lime per acre; (2) $\frac{1}{2}$ cwt. super and $\frac{1}{2}$ cwt. rock phosphate per acre; (3) $\frac{1}{2}$ cwt. super, $\frac{1}{4}$ cwt. blood-and-bone, and $\frac{1}{4}$ cwt. rock phosphate per acre.

—*Fields Division.*

THE ORCHARD.

SPRAYING.

THE most important work for the fruitgrower during the next few months will be spraying. It is now generally recognized that spraying, if it is to give the maximum amount of efficiency, must be carried out at the right time. It is necessary to make a study of the local conditions and to keep a record of the various applications, so that the grower can determine the best times. A great deal of time and material is often wasted by spraying for insect pests during June or early in July. It has been proved that for certain insect pests this is of very little value, and that by deferring the work until a later date much better results will be obtained.

Stone-fruits will be the first to receive attention, as soon as the buds begin to swell. The next in order for treatment will be the pip-fruits, about the last week in August, for the control of red-mite, woolly aphis, and all scale insects, also pear-blister mite on pear-trees. Following these it will be necessary to consider how best to prevent the ravages of black-spot on apples and pears. The following spraying-calendar will serve as a guide during the next two months:—

Fruit.	Pest or Disease.	Spray.	Time of Application.
<i>Stone-fruits.</i>			
Peaches ..	Leaf-curl ..	Bordeaux mixture,	When buds are swelling.
Nectarines ..	" ..	8-6 40 (8 lb. sulphate of copper,	
Plums ..	Bladder-plum ..	6 lb. fresh burnt	About middle to end of August.
Apricots ..	Shot-hole fungus ..	lime, and 40 gallons water)	
Cherries ..	" ..		
<i>Pip-fruits.</i>			
Apples ..	Red-mite and scales ..	Red oil, 1-12 ..	End of August.
Pears ..	Pear-blister mite ..	" 1-12 ..	" "
Apples ..	Black-spot ..	Lime-sulphur, 1-10 ..	At green-tip.
" ..	" ..	" 1-40 ..	When buds show pink.
" ..	" ..	Lime-sulphur, 1 100 to 125; arsenate of lead, 3 lb. paste or 1½ lb. powder	At petal-fall
Pears ..	" ..	Bordeaux, 5-4-40 ..	At tight cluster.
" ..	" ..	" 4-4-40 ..	At pink.
" ..	" ..	" 3-4-40 ..	At petal-fall.

Where varieties of apples are very susceptible to black-spot, and only on those varieties not subject to much russetting, it may be advisable to substitute bordeaux 3-4-50 when buds are showing pink. The last-named applications on apples and pears will need to be repeated throughout the season at intervals of from fourteen days to a month, according to weather conditions and also the amount of disease threatening. Arsenate of lead can be used in conjunction with them for the control of all chewing-insects such as codlin-moth, leaf-roller caterpillar, and bronze beetle, using 3 lb. paste or 1½ lb. powder to every 100 gallons water.

MANURING.

An important point often lost sight of is the manuring of the trees. This accounts in large measure for the poor returns so common from many orchards. It is quite impossible to obtain from fruit-trees adequate returns if sufficient plant-food is not available to build up a good healthy tree. Lack of plant-food means a weak tree, which is more liable to be attacked with disease than trees that are strong and vigorous. Moreover, it is mainly through lack of vigour in the tree that so much injury is caused in the spraying operations.

Soil that is lacking in organic matter should receive a liberal dressing of farmyard manure if obtainable. Failing this, if a good cover-crop has been ploughed under, the trees should be given a good dressing of artificial manure. A complete orchard-manure is made up of the following: Superphosphate, 3 parts; sulphate of potash, 1 part; and nitrate of soda (or sulphate of ammonia), 1 part. These can be combined and, if necessary, applied in one dressing; but the better plan is to mix the superphosphate and sulphate of potash together and apply it at the rate of from 2 lb. to 10 lb. per tree, according to the nature of the soil and the age of the tree. The nitrate can be applied by itself and used only on the trees which are not making satisfactory wood-growth, as it is not necessary on the strong and vigorous trees.

PLANTING.

If intended planting has not already been done it will be necessary to push along with the work when the land is in a suitable condition. All trees should be cut hard back at time of planting, thus enabling the roots and top to commence growth on equal terms.

—*L. Paynter, Orchard Instructor, Christchurch.*

CITRUS-CULTURE.

The harvesting of the orange crop—both Poorman and the earlier-ripening sweet varieties—is the most important work to be carried out during the coming month. It is noticed that citrus brown-rot is very prevalent in a number of orange-groves this season. This is mainly caused by damp conditions often brought about by trees being allowed to grow too densely, and the bottommost branches being allowed to sweep the ground, thus preventing a free current of air. It is most essential that immediately upon identification all diseased fruit should be removed and destroyed. The usual course of treatment for the prevention of this disease should then be carried out in the early spring, in the form of an application of pulverized sulphate of iron, 2 lb. to 3 lb. per tree, forked into the feeding-roots.

The pruning of citrus-trees, where such is required, may now be commenced. The two main features should be the thinning-out of the centres of the trees where too many branches have been allowed to grow, and removal of branches that are crossing one another. Clean cuts should be made in each case, either to an existing lateral or an active bud, it being necessary to refrain from leaving snags which will die back and allow of the entry of boring-insects.

FIREBLIGHT.

That area of commercial orchards which was unfortunate enough to be visited by fireblight during last spring is being reinspected at the

time of writing, for the purpose of identifying any existing hold-over cankers. Nevertheless it behoves all orchardists who are growers of pip-fruits to maintain vigilance throughout the pruning season, with a view to assisting in this direction. It is as well to remember that one active hold-over canker may be sufficient to cause the infection of a wide area of apples or pears. The attention of orchardists and other occupiers of land upon which common white-blossoming hawthorn (*Crataegus oxycantha*) is growing is directed to the following clauses of the regulations under the Fireblight Act, 1922:-

2. In the case of those districts and parts of districts included in the Second Schedule, all hawthorn shall, between the 1st day of June, 1923, and the 31st day of July, 1923, be cut down so as to prevent any part thereof from flowering, and thereafter shall be similarly cut down in the month of June or July in each year and at such other times as may be necessary to prevent any part thereof from flowering.

3. In the case of the district and parts of districts included in the Third Schedule, wherein fireblight is known to exist, all hawthorn growing therein shall be completely destroyed before the 30th day of June, 1923, and any plants which may appear subsequently shall forthwith be completely destroyed.

—J. W. Collard, *Orchard Instructor, Auckland.*

POULTRY-KEEPING.

HATCHING AND REARING.

AUGUST and September generally share as being the best months of the year for hatching out chickens for the renewal of stock. It should therefore be the aim of all poultry-keepers to secure the required number of young birds before the end of September. If chickens are to develop into really profitable stock it is imperative that they be well over the brooder stage before the hot summer weather sets in. The production of late-hatched stock is the weak link on many unsuccessful plants. There are no chickens that do so well as those which develop as the days are lengthening, rather than when they are on the wane.

In regard to the work of rearing young stock, I cannot urge too strongly the necessity of providing the little birds with clean quarters and clean runs. The plant should be arranged in such a way that when the chickens are drafted from the brooder they can be provided with a clean run—preferably one which has been sown down with rape, grass, or other suitable green material. It should be remembered that chickens will develop better on a small piece of clean ground than a large area of tainted soil. In the case of late-hatched stock, a special effort should be made to place the birds on fresh ground. On most plants it will be found that the late birds make poor growth. The common cause of this is that they have to follow stock hatched earlier in the season, and are compelled to run on stale and tainted ground.

The Natural Mother.

In setting a hen the best plan is to make the nest on the ground, and if a box is used the bottom should be taken out of it. The nest should be slightly hollowed out in the centre or saucer-shaped. The hen should be tested with a few china eggs until it is shown that she

will sit steadily and can be entrusted with the eggs intended for hatching. These should be placed in the nest in the evening, and much annoyance and trouble may be avoided if this precaution is taken. Do not neglect to see that the hen is free from vermin. Many fowls leave their eggs just when they are on the point of hatching, because they are being pestered beyond endurance by lice. Before the hen is set she should be dusted with insect-powder. A dust bath should also be provided, so that she can free herself of vermin in nature's way. Care must also be taken that the coop is free from red-mite; a good spraying with strong disinfectant or kerosene will ensure this.

The food for sitting-hens should consist of whole grains, maize being included when available. This, with grit and clean water, is all that is required. Mash, meat, and green food are apt to slacken the bowels and cause the eggs to be soiled, to the detriment of the hatch.

When the eggs commence to hatch do not interfere with the hen; she can manage best by herself. It is only courting trouble to take the chicks out of the nest as they hatch; they should be left to the care of the hen. Chicks do not require food for at least a day after hatching. The coop in which the hen and her brood are placed should be arranged in such a way that the chicks may be kept off wet ground. Care should also be taken that when the chicks leave the nest they can return to it again with ease; many are lost through getting out of the nest and being unable to get back to it. Many also are drowned by jumping into deep water-vessels; this risk should be minimized by using a shallow water-tray.

CHICKEN-POX.

Many complaints have reached me of late regarding outbreaks of chicken-pox. These have been confined to the North Island; this disease is rarely seen in the South Island.

The trouble usually first manifests itself by yellow-crusting nodules of various sizes on the comb and wattles. The disease is highly contagious; therefore as soon as it makes its appearance the affected birds should be isolated and the quarters thoroughly cleaned and disinfected. The next measure is to get the birds' blood in good order, not only in the case of the diseased birds but all others in the flock. For this purpose frequent doses of Epsom salts and sulphur should be given—about 1 oz. of the salts for every twelve birds, dissolved in the water with which the mash is mixed, and a similar quantity of sulphur thoroughly mixed with the dry ingredients of the mash before adding the water. In districts where fowls are subject to this disease periodical doses of salts and sulphur, as directed, will tend greatly towards rendering the birds immune from the trouble. Another important point is to see that the flock are liberally provided with succulent green material. The diseased parts on affected birds should be dressed daily with carbolyzed vaseline. Indeed, as a means of preventing the disease from spreading, it is a good plan to frequently give a light application of vaseline to the combs and wattles of all birds in the flock. After treating a diseased bird care must be taken that one's hands are well disinfected before handling fowls that are free from the disease.

Sometimes chicken-pox is accompanied by diphtheric roup. This takes the form of cheesy matter collecting about the mouth and windpipe, while the breath usually becomes foul. When these two diseases go together and have gained a good foothold there is no telling when the trouble will be stamped out. In bad cases it is better to kill the bird and burn the carcase, as one bad attack renders the victim susceptible to further attacks. In addition to the treatment already stated, and as a cure, the following is recommended: Take a shallow dish or similar receptacle, fill it with pure kerosene, and dip the bird's beak in this sufficiently deep to just cover the nostrils. **Hold** the bird in this position until it breathes: this will have the effect of drawing the kerosene to the seat of the trouble. Repeat the treatment on alternate days until a cure is effected. Another remedy is to place, say, one or two small Condyl's crystals on the end of the finger, and, after moistening them, work them round deep down in the bird's mouth until dissolved. This will cause a discoloration of the bird's mouth and also the finger, which will have a harmless effect on the latter but a beneficial one on the former. The diseased spots in the mouth and throat may also be treated with powdered bluestone, slightly moistened. This may be applied with a fine camel-hair brush or with a feather.

As with most troubles affecting poultry, the only safe policy with chicken-pox is to prevent it. The first essential in this respect is to keep the quarters clean, and by good feeding and proper management maintain the flock in a healthy state, so that the birds may have the power to resist infection should they come in contact with it.

—*F. C. Brown, Chief Poultry Instructor.*

THE APIARY.

PREPARATIONS FOR THE NEW SEASON.

DURING the dormant season every spare moment should be spent in making preparations for next season's work. All defective supers, roofs, and bottom-boards should be overhauled and, where necessary, given a good coat of paint. This work, if delayed, is apt to interfere with the main work in the apiary when the bees are calling for special attention, and should not be postponed.

If it is desired to increase the apiary, hive and frame making should be pushed on, and ample provision made for increase before the actual time arrives for putting preconceived plans into operation. Where the beekeeper does not make his own hives he should now order sufficient stocks to see him through the season. In the majority of cases it does not pay the beekeeper to make his appliances. Hive-manufacturing in the Dominion has been brought to a high standard, and unless the apiarist has ample capital to purchase machinery to turn out good hives he will find the home-made article too costly in the long-run. Whether the beekeeper is working on a small or large scale he should aim at uniformity, and in building up an apiary decide at the beginning on the style of hive and frame he is going to use, and continue on those lines. Non-fitting supers and frames mean extra labour, and lead to endless trouble. In the past, manufacturers have been greatly to blame

for continually altering the type of hive placed on the market, and consequently beekeepers have found great difficulty in keeping appliances uniform. As yet no regular type of hive has been adopted for the Dominion, but the dovetailed hive now so popular among beekeepers is easily the best offered by the suppliers. The sizes in use are mostly ten- and twelve-frame, and experience of his district will enable the beekeeper to decide as to the best one to adopt.

To meet those cases where cost is a consideration a durable frame hive can be made out of a petrol-case, which will comply with the provisions of the Apiaries Act. Petrol-cases are obtainable for a few pence, and can be readily converted by any one handy with tools. A kerosene-case may also be used, but it will be found necessary to reinforce it, so that the petrol-case is the handier. Particulars of a cheap home-made hive are given in Bulletin No. 55, "Bee-culture."

Overhauling the hives: As advised last month, all supers should be removed and the bees confined to the brood-chamber. This will keep the bees snug and promote brood-rearing, and at the same time facilitate the work of giving the hives their first spring overhaul. During the course of the winter there is usually an accumulation of pollen, dead bees, &c., on the bottom-boards, and consequently the latter require cleansing. All operations at this period should be carried out quickly as a safeguard against robbing. To cleanse the bottom-board bring into use a spare one. Set the hive temporarily on the spare board while scraping and cleansing the permanent one, then replace the hive on its permanent stand. See that the hives have a slight cant towards the entrance. This will prevent moisture settling on the bottom-board, which is apt to cause the death of a considerable number of bees, besides making the hive damp and unwholesome.

Containers for export: A mistake often made by beekeepers who prepare bulk honey for export is to leave the preparation of their containers until the honey is extracted. Supplies of tins should be obtained in the off-season, when more time and care can be spent in seeing that they are fit to contain the season's crop. All these, whether intended for export or the local market, should be carefully cleansed and dried prior to giving them a coat of oil or lacquer. From experience gained at the grading-stores, it is apparent that beekeepers do not pay sufficient attention to packing. The tin is looked upon as a mere container, and is treated as such. Efficient methods of packing for export are required, and not the slipshod packing adopted in the past for auction-room sales.

SPRING WORK.

During August, whenever the temperature will allow, the colonies may be given their first examination. It is highly important that this work should not be postponed until brood-rearing has started in earnest, more especially in cases where ample stores were not left to carry the bees over the early stages of this important function. Delay in making an examination may lead to spring losses, and nothing is more tantalizing than to find colonies dead through neglect to provide sufficient stores. Usually a colony's requirements are attended to in the late autumn, when the apiarist endeavours to gauge the amount of food requisite to carry the bees through the winter and spring periods. It may happen, however, that mild weather will be experienced, when the

drain on the stores to feed the young bees, if not supplemented, will reduce a colony to starvation. Nothing should be left to chance during the critical months of spring, and no effort spared to see that each individual colony has sufficient food to meet current demands. Colonies which contain 15 lb. to 20 lb. of honey may be left until a later examination. If the hives contain less they should be watched closely and preparation made for feeding. See Bulletin No. 55, page 37, regarding the spring feeding of bees.

Queen-right colonies : Next to the item of stores the most important factor in a colony's condition is its queen. Advantage should be taken of the first examination to see that the queen is all right. If a colony is in normal condition as regards strength and stores there should be fair-sized patches of brood in the centre frames, but this is not sufficient to determine that the colony is queen-right. The cells adjacent to the brood should be quickly examined for eggs, which are the only indication that the queen is present. If neither brood nor eggs are found, then shelve the question of the colony being queenless till about ten days later. At each examination make a note of each hive and its condition for future reference.

—*E. A. Earp, Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

PEAS sown, and lettuce, cabbage, and broccoli planted out in late autumn, should now receive every attention to bring them along to early maturity. If not already done, plant out autumn-sown onions, shallots, and garlic, and sow peas, lettuce, radishes, and main-crop onions—for preference on areas devoted to root crops and celery last season. The parsnip main crop, early carrots, and white turnip, as well as the early potato crop, which should be sown and planted now, are best allotted to the heavily manured areas which have been carrying cabbage, broccoli, &c. Cabbage and cauliflower plants sown earlier should be planted out as soon as ready; for them the land cannot be too rich.

Rhubarb-beds will be coming into growth and should receive liberal treatment. A heavy dressing of stable manure and 3 cwt. of superphosphate per acre will suit the average beds. Follow this up with one or two applications, at intervals, of nitrate of soda, 2½ cwt. to the acre (1 oz. to the square yard). After a bed has been down for four years or so it should be taken up and a fresh plantation made. Old stools from such a bed may now be lifted, cut up, and planted out into a piece of well-prepared land. Work in a dressing of superphosphate before planting.

Asparagus-beds require a somewhat similar generous treatment. Where nothing has yet been done clean up the beds and apply a good dressing of partly decayed stable manure, following this up in August with 2 oz. each of superphosphate and sulphate of potash to the square yard. Applications of nitrate of soda and salt, of which this plant is fond, are best deferred for the present. If it is intended to plant out new beds prepare the land now for planting out in early September; seed, or plants two or three years old, may be used. As such beds have

to remain down for some years they should be made deep and rich, remembering that the plant likes abundant moisture during the growing season ; it also requires perfect drainage.

Tomatoes.—Where a tomato crop is to be grown under glass the plants will now be well under way. Every advantage should be taken of fine warm weather to admit air and keep the plants firm and sturdy. Before planting them out towards the end of August lightly work in a dressing of chemical manures. Where the usual practice of growing and turning in a green crop has been observed, no nitrogenous manures will be required at this stage, the tomato-plant not being a gross feeder. A mistake under this heading usually leads to sterility and liability to many troubles, including black-stripe, which under such circumstances is difficult to control. A usual dressing at this stage consists of 7 oz. superphosphate and 4 oz. sulphate of potash to each 3 square yards. Where the preparation of the land has been delayed the soil is often loose and free, and plants set in such ground have their growth checked for a time. The tomato prefers a firm bed. Set the plants rather deep and firmly in the ground.

For outside culture tomato-seed may be sown now in boxes and raised in a frame on a hotbed. It is at such a time as this that a well-conditioned compost is of value. Such soil is of the right mechanical condition and contains suitable plant-foods. Of a correct moisture, sweet, and free from insect and fungus troubles, seedlings make uninterrupted progress in such a soil. On the other hand, soil taken direct from the garden and mixed with decaying vegetation and manures immediately before sowing is usually unsuitable ; seedlings damp off and experience many infantile troubles that are annoying ; results from such plants are very uneven.

The hotbed, too, is often hastily prepared, and as a result the temperature is uneven and of brief duration. Have the materials on hand in good time and place them in a compact heap to heat. After a few days, when this has taken place, the material must be shaken out and restacked, watering any portions that are dry. When it has heated up again repeat the operation, and in a few days it should be of an even consistency and ready for use. In building the bed, stack the materials evenly and tread them down firm. In a few days a steady heat will again have generated, when the frame can be put into position and the hotbed will be ready for use. Such a bed will maintain a steady heat for a long period and give good service.

Kumaras.—A place in such a frame is just the requisite position for starting kumaras. As stated in the Department's Bulletin No. 78, in the month of August tubers of the previous season's growth should be laid close together—but not touching—on a 1 in. layer of clean sand, and then covered to a depth of 4 in. with a sandy loam, or, more preferably, clean sand, and kept moderately moist. In four or five weeks' time the buds will have sprouted, and when the young shoots are 6 in. in length they are carefully removed and heeled closely in a well-sheltered and sunny position, and provision made so that they may be readily covered with scrim should there be any danger of frost. However, in the case of this crop a glass sashlight can be dispensed with if it is not available, and a good calico cover used instead.

Early and second-early potatoes should be got in as soon as the land is ready. A dressing of 3 cwt. superphosphate and 1½ cwt. sulphate of

potash per acre, hoed in just before planting, is of great assistance. Put the hoe through again as soon as the plants show above the ground.

SMALL-FRUIT.

Where it is intended to plant strawberries the work should now be taken in hand without delay. It is necessary that the land be clean and in good heart; the first condition is most important, and planting should not be proceeded with without it. In such a case sow a temporary crop and complete the cleaning of the land. As to the second condition, if there is any doubt, work in a good dressing of blood-and-bone manure. Spare no effort to get strong well-rooted plants of the right kind free from disease. Leaf-spot is one of the commonest troubles; at the first sign of it spray with bordeaux, 4-4-40 formula.

The growing of the edible passion-fruit is now receiving more attention. Seed sown during the autumn will now have developed into good strong plants, which will be ready for their permanent quarters in September. As with all permanent crops, the ground requires special preparation, for only superficial cultivation can be given later. To stand heavy cropping this plant requires generous treatment. This preparation should be completed during the coming month.

The Cape gooseberry is in considerable demand as a conserve, and those who have light well-drained sunny slopes would find it a profitable crop. Plants should be ready for planting out towards the end of October; sow the seeds now and place the boxes on a hotbed. Also commence the preparation of the land for the plants' reception, turning in any weeds or other vegetation growing there so that they may have time to rot before planting. Beds that cropped last season and are to be cropped again this year may be allowed to remain as they are for the present, until the danger of hard frosts is passed. The litter will protect the new shoots to some extent meanwhile.

Bush-fruits that have not yet had their winter bordeaux spray should receive it now. If the plants have started into growth weaken the mixture to, say, 4-4-40.

TOBACCO-CULTURE.

Tobacco—for smoking purposes—is now being grown extensively in some districts. It is very noticeable at the moment that the best leaf in the past season's crop was grown from plants that matured early—about the end of January. These plants were from seed sown early in August and planted out in October. The success of this crop depends so much on the critical period between germination and transplanting that too much care cannot be given to the preparation and management of the seed-beds.

Many of the troubles with weeds and fungus diseases would doubtless be overcome if the practice were in vogue that is general in the tobacco-growing sections of the United States and has been adopted by some of the more successful growers in Australia. It is that of burning the land to be used as a seed-bed, and is described as follows: "The land for the seed-bed should be cleared of rubbish and then burnt. As too much of the soil organic matter will possibly be burnt if the fire rests directly on the surface, poles of 3 in. or so in diameter should be placed across the plot to carry the fire, and on these fuel,

such as dry bushes, straw, &c., will be piled to a height of 4 ft. The fire should be started on the lee side of the heap to ensure a slow burn. The unburnt pieces of fuel should afterwards be raked off. 2 lb. superphosphate (or bonedust) and 1 lb. nitrate of soda (or sulphate of ammonia) should be applied to the bed (1 yard wide by 9 yards long, sufficiently big to grow plants for an acre), and the land then worked finely to a depth of 3 in. or 4 in." This operation should be carried out when the land is normally dry; land too wet for cultivation is too wet for burning.

Seed-beds on an easy slope facing the north, well sheltered, and sterilized in this manner should grow early plants if protected with a good calico or hessian cover. Used with discrimination, such a cover will prevent the bed drying after the seed is sown—an event that must not be allowed to happen—and also be a great protection against frost.

If not already commenced, preparation of the land for the tobacco crop should be got under way; it takes time as well as labour to get soil into a clean friable condition with all the vegetable matter well rotted down. In selecting areas for this crop it is to be remembered that it is not the heaviest land which is best. The lighter-coloured tobaccos that are in demand do best on a medium-quality porous soil.

For those unaccustomed to this crop it may be mentioned that it is usual to sow an even tablespoonful of seed to 50 square yards. To distribute it satisfactorily mix it with a pint of meal, sand, or ashes. After sowing, the seed should not be covered, but pressed into the ground firmly with a board or roller. Frame the seed-beds round with boards placed on edge to a height of 6 in., and cover with a hessian cloth.

HEDGES.

A green live hedge in good condition and suitably placed can be highly ornamental and of great utility. Difficulty is sometimes experienced in keeping such hedges in condition, investigation has shown many hedges to be thin and weak, and frequently heavily parasitized by insect blights. In most instances the primary cause is heavy cutting at unseasonable periods of the year. Should such drastic treatment be necessary, it is most important to perform the operation at the right season. For deciduous hedge-plants any time during the dormant period is suitable, while evergreens requiring heavy cutting should be dealt with in early spring. At that period hedges infected with insect parasites should be trimmed close in and the clippings burnt. The hedge should be afterwards immediately sprayed thoroughly with a good insecticide, repeating the application again in about a fortnight. Most hedges may, of course, be trimmed during the summer, but on such occasions it is usual to trim back the growth of the current season only.

LAWNS AND GREENS.

Most of our summer sports demand a smooth even turf for satisfactory performances. Such a high condition cannot be obtained satisfactorily by hasty work at the last moment. It is best to join forces with nature and give what assistance is necessary in the early spring. Weak lawns will require a top-dressing of a good compost, which should be prepared some time before it is applied, and should

consist chiefly of a clean fresh loam with a generous admixture of chemical fertilizers. Thoroughly rake over the green before applying it.

The benefit a green receives from the frequent application of a heavy roller is generally understood, but too often it is put off till the season's play is about to commence, when perhaps more harm than good is done by generous hosing and the almost endless use of the roller. Such attentions should be commenced now while the ground is really damp. On light soils especially the commencement can hardly be too early, as long as the frost is out of the ground. Ample rolling from time to time during the spring, with occasional applications of chemical fertilizers in solution, will result in a turf that will stand a lot of hard wear in the summer.

W. C. Hyde, Horticulturist.

PRESERVATIVE TREATMENT FOR SOFTWOOD POSTS.

THE following reply has been supplied by the State Forest Service to a correspondent of the *Journal* who inquired regarding the preservative treatment of *Pinus insignis* for fencing-posts:—

Mr. Orton Bradley, of Christchurch, has forwarded to this office specimens of *Pinus* posts and pegs impregnated with coal-tar, which have given a life of over twenty years. These posts probably contained much more material than was actually required to preserve them, the wood being very absorbent. In applying any preservative treatments certain fundamental precautions must be observed. The timber should be thoroughly seasoned and all traces of both outer and inner bark removed. The adherence of a small piece of inner bark, perhaps only $\frac{1}{16}$ in. thick, may prevent any penetration of the preservative at this point, and decay will be almost sure to occur. If no cheap creosotes are available the crude tar may be used with advantage. It will be necessary to treat the whole of the post if *Pinus insignis* timber is used. In the interest of economy it will not be necessary to give as heavy a treatment to the top portion as to the butt of the posts. This could be effected by placing the posts upright in a tank of the preservative so that approximately the whole of that portion which goes in the ground, plus 6 in., may be in the solution. After sufficient tar has been absorbed by the posts they should be transferred to another tank where they may be placed lengthwise under the solution. They will not require to be left as long in this bath as in the first, as the tops will not require such a heavy absorption as the butts. The object of the treatment is to secure a deep enough penetration of the preservative, and in sufficient quantities to resist the attack of insects and fungi. Tars vary in composition to such an extent that no set times for treatment can be given. The penetration may be tested by drilling augur-holes in the treated timber. A satisfactory treatment will be attained when the whole of the sapwood has been penetrated by the tar. This is easily ascertained from the colour of the treated wood.

Imported Chaff and Weed-seeds.—At the last meeting of the Board of Agriculture a letter from the Director General of Agriculture regarding the inspection of imported chaff was discussed. Members thought there was great need of further legislation to give power to the Department to order any such chaff which on examination was found to contain quantities of rubbish and seeds of weeds to be destroyed, if necessary, or to be subject to thorough cleaning so as to free it from deleterious seeds. The Board decided to ask the Minister to give further powers to Inspectors to deal with chaff, seeds, and plants found likely to bring weed-seeds and diseases to the Dominion.

New Rabbit District.—The constituting of the Maioro Rabbit District (Franklin County), for the purpose of Part III of the Rabbit Nuisance Act, was gazetted on 19th June.

WEATHER RECORDS: JUNE, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE first half of the year, completed with June, will be remembered in the North as a period of heavy rain. Rainfalls in June were also much above the average in the high levels of the South, but below normal in some of the east-coast districts of both Islands. Other parts of the country varied little from the average of the same month in previous years. There were several falls of snow on the ranges, but these quickly thawed, and the winter season so far has, on the whole, been rather mild, though frosts were frequent in the east-coast districts of the South Island. One of our observers in Southland ventures to remark: "The weather has been far too good for this time of the year—too mild. There are still too many blowflies about, and unless it becomes much rougher in July and August spring and autumn are not likely to be good."

There were four distinct westerly disturbances during the month, which culminated on the 8th and 12th, and two which passed in the South on the 18th and 24th, while the weather between the 17th and 27th was very unsettled, with heavy showers in most parts of the country. An ex-tropical cyclone passed in the north and east-coast districts on the 14th and 15th, causing easterly gales and tremendous seas on the east coast, especially about Gisborne and Napier.

As is usual in winter months, storms alternated with periods of calm. On the whole, in winter the total velocity of the winds is usually less than in summer.

—D. C. Bates, Director.

RAINFALL FOR JUNE, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitiaki	8.56	19	1.20	5.53
Russell	7.35	16	3.25	6.28
Whangarei	7.16	17	1.71	5.26
Auckland	6.60	21	1.92	4.79
Hamilton	6.26	19	1.99	5.07
Kawhia	9.28	21	1.54	5.46
New Plymouth	5.14	24	0.77	6.21
Inglewood	9.95	23	1.50	10.31
Whangamomona	9.42	23	2.14	7.92
Tairua, Thames	6.94	11	3.10	6.95
Tauranga	4.65	19	1.41	5.05
Maraehako Station, Opotiki	8.26	14	4.14	5.68
Gisborne	4.44	15	1.06	5.21
Taupo	5.14	12	1.50	4.35
Napier	1.72	10	0.38	2.45
Maraekakaho Station, Hastings	1.69	16	0.36	3.33
Taihape	5.09	22	1.29	3.79
Masterton	4.02	20	0.79	3.41
Patea	3.75	19	0.63	4.40
Wanganui	3.71	12	0.59	3.29
Foxton	3.70	12	1.00	2.83
Wellington	2.96	21	0.56	4.87
<i>South Island.</i>				
Westport	6.31	19	1.10	7.53
Greymouth	6.40	15	0.98	8.99
Hokitika	9.54	15	1.36	9.72

RAINFALL FOR JUNE, 1924—continued.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average June Rainfall.
<i>South Island—continued.</i>				
	Inches.		Inches.	Inches.
Arthur's Pass	22.28	11	4.37	9.77
Okuru, Westland	9.86	10	2.00	10.76
Collingwood	13.44	12	3.54	11.33
Nelson	3.34	9	1.40	3.75
Spring Creek, Blenheim	2.66	6	1.50	3.23
Tophouse	9.01	11	1.89	4.99
Hammer Springs	4.90	13	1.37	2.83
Highfield, Waiau	1.78	8	0.40	2.50
Gore Bay	2.17	9	0.45	2.30
Christchurch	1.98	12	0.51	2.64
Timaru	0.55	6	0.23	1.84
Lambrook Station, Fairlie .. .. .	..	..	..	2.06
Benmore Station, Oamaru	2.05	6	0.85	2.06
Oamaru	0.99	5	0.40	2.11
Queenstown	4.56	11	1.16	2.41
Clyde	1.02	8	0.37	0.98
Dunedin .. .. .	..	..	..	3.13
Gore	2.79	15	0.47	2.76
Invercargill	4.16	19	0.64	3.54

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 15th May to 10th July, 1924, include the following of agricultural interest:—

No. 50486: Animal-trap; W. H. Thomas, Southland. No. 51622: Garden-propagating-frame heating; C. Hancock, Letchworth, England. No. 51798: Cheese-making rack; H. H. Gilshnan, Te Kiri. Nos 48932 and 50385: Milk-pipe union; F. Allen, Dannevirke. Nos. 48965 and 48996: Milking-machine milk-measuring means; O. H. Burt, Featherston. No. 49923: Cow-milker apparatus; J. B. MacEwan and Co., Ltd., Wellington. No. 49982: Milking-machine pulsator; C. F. Lumley and M. Lumley, Featherston. No. 50024: Milk-cleaning means; R. F. Searle, Matamata. No. 50155: Garden tool; R. A. Martin, Taradale. No. 50356: Milking-machine releaser; C. A. Martin, Hamilton. No. 51072: Cheese-mould; G. Gray, Stratford. No. 51692: Meat, fruit, and fish preserving; X. Simon, Buenos Aires. No. 51744: Teat-cup brush; W. Cavanagh, Te Awamutu. No. 51810: Tilling-tool, yoking to tractor; R. Mozer, Geneva, Switzerland. No. 50083: Milking-machine claw and pulsator; R. C. and R. G. Green, Peria. No. 50150: Milk and cream aerating and cooling; C. E. Hardley, Auckland. No. 50179: Milking-machine; A. Sabroe, Denmark. Nos 50298 and 50443: Milking-machine releaser; K. G. Watson and D. McMahon, Te Aroha. No. 50407: Pasteurizer milk- or cream-flow control; L. Hansen, Christchurch. No. 50562: Bale-fastener; S. H. Hughes, Victoria. No. 51186: Cheese-mould; R. Wyeth, Orawia. No. 50195: Milking-machine pulsator; R. B. Forsyth, Christchurch. No. 51932: Fruit-grader; R. Burgess, Spring Creek. No. 50386: Wool-deburring machine; C. C. Masey, Victoria. No. 51879: Incubator and foster-mother; C. Hancock, England. No. 49398: Sprayer; B. F. Mitchell, Auckland. No. 50050: Fencing-wire attachment to concrete post; H. W. Snelling, Auckland. No. 50497: Milking-machine teat-cup inflation; R. N. Pilkington, Hamilton. No. 50741: Hay-sweep; C. Hansen, Waihi. No. 51153: Weeding-device; C. H. Pugh, Ltd., and G. F. Bute, England. No. 51948: Fertilizer; J. C. Hutton Proprietary, Victoria.

Copy of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington. Price, 1s.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

PRECAUTIONS REGARDING CONTAGIOUS MAMMITIS.

"INTERESTED," Tauranga :—

I have a cow that developed contagious mammitis shortly after calving about eight months ago. She was turned out then, and has been running with a calf ever since. The calf has been sucking all her teats, and there is no sign of a hard quarter now. I would like to know if the trouble would be likely to recur upon calving this year, and, if not, whether the cow would still be a source of infection to the others.

The Live-stock Division :—

If the cow suffered from contagious mammitis eight months ago the organism of the disease may still be present in the milk, although the udder may appear normal. In order to ascertain if the organism is still present, the milk should be microscopically examined. If you will forward a sample of the milk to the Officer in Charge, Veterinary Laboratory, Wallaceville, Wellington, he will, after examination of the milk, be able to advise you on this point. Before taking a sample the calf should be kept from the cow. During the night the teat of the affected quarter should be thoroughly cleansed, and the first portion of the milk caught in a sterilized bottle and forwarded for examination.

RIDDING PLUM-TREES OF MOSS.

"NOVICE," Awhitu :—

Please inform me as to the best method of getting rid of moss from some Burbank plum-trees which have been neglected for some time. The trunk and branches are fairly thickly covered with this growth.

The Horticulture Division :—

To rid the plum-trees of an accumulation of moss remove the worst of it from the trunk and main limbs with a scraper. Later—just before spring growth commences—apply thoroughly a spray of bordeaux mixture, winter strength. Follow with another application, summer formula, just as the flower-buds show white. Details for making these mixtures will be found in the Department's Bulletin No. 82.

BLINDNESS IN DOGS.

N. TYERMAN, Owango :—

I have two dogs both partly blind, and I wish to know if anything could be done to restore their sight. The dogs are full brothers, and about three years old. One has been partly blind for about twelve months, and lately the other has shown exactly the same symptoms. The trouble seems to be caused by the expanding of the pupils of the eyes to about the full size of the eye. The dogs appear able to see better at a distance than close at hand. Both are in good health and have always been so.

The Live-stock Division :—

Without an examination of the animals it is somewhat difficult to advise you. We are of the opinion, however, from the symptoms given, that the animals are suffering from cataract. This is a condition in which the lens of the eye loses its transparency. In the earlier stages of the disease the animal, although able to see, is unable to measure distance: the complaint invariably ends by causing total blindness. Further than keeping the animal in good health, little can be done in this disease by way of treatment.

REMOVING CATTLE FROM TICK-INFESTED COUNTRY.

"NORTH AUCKLAND," Waipu :—

I have put my cows to graze on tick-infested property, and wish to know when I should remove them to avoid the possibility of their coming back laden with ticks. They were put out on 28th May, and are due to calve about the middle of August. Please advise me of the latest date for safety.

The Live-stock Division :—

There is no period of the year when stock can be removed with safety from tick-infested country. Although mature ticks are not seen on stock during the winter months, there is always the danger that the animals are harbouring seed-ticks, and these, while difficult to detect, can easily infest clean areas if carried there by stock. In order to ensure that these parasites are not brought to your farm, the cows should be thoroughly sprayed with a solution of cattle-dip before they leave the affected area

WORMS IN PIGS.

"INQUIRER," Ashburton :—

Could you please tell me the cause of and cure for worms in pigs?

The Live-stock Division :—

The inquiry covers a very wide field, as pigs may become affected with a variety of parasites classed as worms, the cause and treatment varying with the variety affecting the animal. It is probable that the particular worm regarding which you desire information is a large white one called *Ascaris lumbricoides*. It is more or less frequently found in the intestines of pigs, and if in large numbers causes digestive troubles, unthriftiness, &c. Pigs become affected by ingestion of food or water affected with the eggs or ova of the adult worms. These eggs or ova can be found in the droppings or fæces of pigs affected with the worms. Insanitary conditions and overcrowding help to spread the trouble. The following treatment is recommended: Give the pigs no food for twenty-four hours, then give 1 dram (a level teaspoonful) of freshly powdered areca nut thoroughly mixed with 1½ pints of milk for each half-grown pig (it is usually young pigs which are affected). Four hours afterwards give the following purgative: Epsom salts, 2 oz., dissolved in warm water, and mixed with 2 quarts of milk for each pig. Care should be taken to see that each animal gets its proper dose. It is advisable to repeat this treatment twice at intervals of eight days. The discharges from the pigs should be cleaned up and burnt immediately after the animal ceases to purge, otherwise the eggs will reinfest the pigs. Another method of treatment is to give 8 grains of santonin mixed in the feed on two consecutive mornings, and on the third morning give 8 grains of calomel mixed in the feed.

NEW-MILK SUBSTITUTES FOR CALVES.

"COW-SPANKER," Wanganui :—

Could you please inform me what is the best, cheapest, and easiest substitute for new milk to give to young calves, along with skim-milk?

The Live-stock Division :—

There are many recipes for substitutes for new milk in calf-rearing. A good one is six parts of oatmeal to one of ground linseed. An amount of 2 lb. of this mixture per calf is scalded overnight with 5 pints of boiling water. In the morning this should be boiled for ten minutes, adding 5 or 6 pints of separated milk, with a little salt and sugar. This is divided into two or three parts to be fed during the day. The following are also suitable recipes: (1.) 3 quarts linseed-meal, 4 quarts bean-meal, 30 quarts boiling water. Cover for twenty-four hours and give equal proportions of mixture and warm skim-milk. (2.) Finely ground linseed-cake, 7 lb.; mixed meal, 7 lb.; hot water, 7 gallons. Give as above.

Importation of Horses from Fiji.—Regulations relating to this matter were gazetted on 26th June. They are to be read with and form part of the regulations under the Stock Act gazetted on 7th October, 1915.

PLANTATIONS ALONG BOUNDARY-FENCES.

THE following inquiry was received recently from a station-owner: "Last year I put in a plantation along a boundary-fence. The nearest trees are 6 ft. from the fence, but my neighbour objected to this plantation, in writing, three months after it had been put in. I did not ask his permission to plant. He now expects me to root out the entire plantation. Is he legally entitled to force me to do this? I should be much obliged for information." The point being an important one of wide interest, the reply made by the Department is published hereunder:—

The position is governed by section 26 of the Fencing Act, 1908, which reads as follows:—

"No person shall, whether for the purpose of making a live fence or otherwise, plant or sow gorse or trees—(a) On or alongside any boundary line or fence without the previous written consent of the occupier of the adjoining land; or (b) on or alongside any boundary line or fence bounding or abutting on any Crown lands, public reserve, or railway without the previous written consent of the proper authority having the management or control thereof.

"(2.) No person shall under any circumstances or for any purpose plant or sow sweetbrier, bramble, or blackberry on or alongside any such boundary line or fence as aforesaid.

"(3.) Every person who commits a breach of any of the provisions of this section is liable for every such offence to a fine not exceeding twenty pounds.

"(4.) Irrespective of any such fine, the occupier or proper authority as aforesaid may enter on the land and cut down, uproot, and destroy all gorse or trees, sweetbrier, bramble, or blackberry planted or sown in breach of this section, and may recover the cost of so doing from the person who planted or sowed the same."

The question as to what constitutes "alongside any boundary-line" has not, so far as we are aware, been determined, but it was held by the Court of Appeal in the case *Spargo v. Levesque* (New Zealand Law Reports, 1922) that the right of an occupier to enter adjoining lands and to cut down and destroy trees planted thereon in breach of section 26 of the Fencing Act, 1908, could only be lawfully exercised after proceedings had been taken against the person planting the trees for a breach of the section and a conviction obtained.

Section 37 of the Fencing Act provides that all proceedings before a Magistrate in respect of any of the matters in regard to which he has jurisdiction (see section 36) shall be by summons in the prescribed form, and such proceedings shall be conducted and all orders thereon by the Magistrate may be made, enforced, and acted upon in like manner as in the case of summary proceedings under the Justices of the Peace Act, 1908. Sections 48 and 49 of the latter Act deal with the procedure preliminary to the hearing of a case, and these are quoted for your information:—

"48. Where a person is charged before a Justice with the commission of an offence for which he is liable to be punished on summary conviction before Justices, the information shall be taken in writing, and shall be in the form (No. 4) or to the effect thereof; but it need not be substantiated on oath, unless it is intended to issue a warrant to compel the appearance of the person charged.

"49. Every such information shall be laid within six months from the time when the matter of such information arose, except in cases where some other period of limitation is provided by the Act constituting the offence or any other Act."

If the position is that no information was laid by your neighbour within six months, then it would seem that he has forfeited his legal right to objection, but this is a point of law upon which the Department is not able to definitely advise you.

Rabbit-control.—Regulations relating to the destruction of rabbits in the Kiwitea Rabbit District were gazetted on 19th June. They empower the Board to prevent trapping in the district.

REGISTRATIONS OF FACTORIES, ETC., UNDER THE DAIRY INDUSTRY ACT: 30th April, 1924.

District.	Creameries (Butter).	Factories (Cheese).	Dual Plant (Butter and Cheese).	Private Dairies.		Packing- houses (Milled Butter).	Totals.
				Butter.	Cheese.		
Auckland	64	46	6	..	..	1	117
Taranaki	18	79	34	..	..	..	131
Wellington	16	54	11	..	..	1	82
Hawke's Bay	11	16	3	..	..	..	30
Nelson	6	4	1	..	..	3	14
Marlborough	4	4	3	..	..	..	11
Westland	8	2	..	..	..	..	11
Canterbury	12	14	3	..	6	..	35
Otago and Southland	17	75	2	..	..	..	94
Totals	156	294	64	..	6	5	525

Seven milk-powder factories (four whole-milk and three skim-milk plants), one condensed-milk factory, one sugar-of-milk factory, and three casein-factories are also established in the Dominion

REGISTRATION UNDER THE FERTILIZERS ACT.

THE Fertilizers Act, 1908, requires every vendor of fertilizers to register his name and address before offering any fertilizer for sale, and thereafter on or before 1st July in each year. The Act defines a vendor as any person who, either on his own account or on behalf of any other person, sells in the ordinary course of his business any fertilizer. Storekeepers and others who act as agents for manufacturers and mixers of fertilizers are therefore "vendors." Vendors who carry on business at more than one address are required to register each address. It is sufficient if the addresses of all the branch establishments are stated on the head office registration forms.

It should be noted that, where a vendor has already registered a fertilizer during the current year, it is not necessary again to register the same particulars on 1st July. Many vendors are evidently under the impression that the registration year commences on 1st July, and that all fertilizers must then be registered afresh. This is not so. A second registration during any year (January to December) is necessary only where the previously registered particulars of a fertilizer require amendment.

On each sale of 5 cwt. or more the vendor must supply the purchaser with an invoice certificate showing the true particulars of the fertilizer as registered. All packages must be clearly and distinctly branded with the registered brand; provided that where any mixture is made up according to the written instructions of the purchaser it is sufficient to brand the packages "Special mixture."

British Market for Peas and Beans.—The following information was cabled by the High Commissioner, London, on 5th July: *Peas* (Blue)—Demand is limited. Japanese shipments about to arrive quoted at £19 15s. to £20 10s. c.i.f.; spot, £20 to £21 per ton. In new crop September–October shipments business is being done at £20 c.i.f. Dutch small round hand-picked, £20. Tasmanian "A" grade, £18 c.i.f.; spot value about £20 10s. for best quality only. New Zealand good quality worth £17 to £18. (Maple)—English in small supply. "A" grade Tasmanian on passage worth 72s. to 76s. per quarter. New Zealand Partridge No. 1 for shipment, 62s. 6d. to 65s. c.i.f. *Beans*—English selling at 47s. to 50s. per quarter; no inquiries for imported.

LIST OF QUALIFIED VETERINARY SURGEONS.

THE following list of qualified veterinary surgeons known to be residing in New Zealand is published for the guidance of stockowners and for general information. In the event of the name of any properly qualified veterinarian being omitted it is requested that he communicate with the Director of Live-stock Division, Department of Agriculture, Wellington, giving particulars of his qualification, in order that the necessary steps may be taken for the inclusion of his name in the next published list.

Aberdeen, C., L.V.Sc. (Melb.), Wanganui.

*Ashe, G. G., M.R.C.V.S., Belfast.

*Barnes, A. W., M.R.C.V.S., Hastings.

*Barry, W. C., M.R.C.V.S., Auckland.

Bayley, A., M.R.C.V.S., Hawera.

Begg, W. F., M.R.C.V.S., Te Awamutu.

*Blair, W. D., M.R.C.V.S., Invercargill.

*Blake, T. A., M.R.C.V.S., Masterton.

Brodie, A. M., M.R.C.V.S., Hastings.

*Broom, G., M.R.C.V.S., Gisborne.

Burton, S., M.R.C.V.S., Hamilton.

Carbury, H. W., M.R.C.V.S., Otorohanga.

Cockcroft, J. E., M.R.C.V.S., Feilding.

*Collins, W. T., M.R.C.V.S., Wellington.

Crossley, F., M.R.C.V.S., Palmerston North.

Cunningham, T., M.R.C.V.S., Oamaru.

*Danskin, J., M.R.C.V.S., Dunedin.

*Dayus, C. V., M.R.C.V.S., Auckland.

*Elphick, E. E., M.R.C.V.S., D.V.H., Wellington.

Fletcher, S., B.V.Sc. (Melb.), Whakatane.

*Gill, D. A., M.R.C.V.S., Palmerston North.

Glover, F., M.R.C.V.S., Hamilton.

Gregory, J. S., B.V.Sc. (Melb.), Leeston.

*Hickman, A. J., M.R.C.V.S., Auckland.

Hankin, T. H., M.R.C.V.S., Pukekohe.

*Haugh, P., M.R.C.V.S., Petone.

*Hopkirk, C.S.M., B.V.Sc. (Melb.), Wallaceville.

*Howard, E. C., M.R.C.V.S., Wanganui.

Johnson, A. A., F.R.C.V.S., Christchurch.

*Kerrigan, J., M.R.C.V.S., Christchurch.

Kyle, H. S. S., G.M.V.C. (Melb.), Templeton.

*Lawson, J. N., B.V.Sc. (Sydney), Wanganui.

*Le Souef, H. D., B.V.Sc. (Melb.), Wellington.

*Lukey, E. J., B.V.Sc. (Melb.), Christchurch

*Lyons, J., M.R.C.V.S., Auckland.

*Mackenzie, A., D.V.S.M., M.R.C.V.S., Hamilton.

*Marsack, H. L., V.S. (Ontario), Auckland.

Marshall, D., M.R.C.V.S., Balclutha.

Martin, H. E., M.R.C.V.S., Christchurch.

*McGregor, P., M.R.C.V.S., Christchurch.

*Meade, R. H., M.R.C.V.S., Palmerston North.

Miller, J., M.R.C.V.S., Invercargill.

*Paterson, A. M., M.R.C.V.S., Timaru.

Quinnell, W. C., M.R.C.V.S., Wellington.

*Reakes, C. J., M.R.C.V.S., D.V.Sc., Wellington.

*Reid, H. A., F.R.C.V.S., D.V.H., F.R.S.E., Wellington.

Ring, W. C., V.M.D. (Penn., U.S.A.), Ellerslie.

Siddall, E. L., M.R.C.V.S., Opotiki.

Simpson, C. S., M.R.C.V.S., Auckland.

*Snowball, W. D., M.R.C.V.S., Dunedin.

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Taylor, A., F.R.C.V.S., Christchurch.

Taylor, H. C., M.R.C.V.S., Dannevirke.

Taylor, J. B., M.R.C.V.S., Waverley.

Taylor, W. G., M.R.C.V.S., Wellington.

Thompson, A. L., M.R.G.V.S., Stratford.

*Wood, R. B., M.R.C.V.S., Waitara.

*Young, A. R., M.R.C.V.S., Wellington.

* Officers of the Department of Agriculture.

† Not practising as a veterinary surgeon.

STOCK SLAUGHTERED, 1923-24.

THE following are the numbers of stock slaughtered at abattoirs, meat-export works, bacon-factories, and ordinary registered slaughterhouses throughout the Dominion during the year ended 31st March, 1924 :—

Stock.	Abattoirs.	Meat-export Works.	Bacon-factories.	Ordinary Slaughterhouses.	Totals
Cattle ..	143,961	184,848	..	82,225	411,034
Calves ..	35,375	18,776	..	2,372	56,523
Sheep ..	570,350	1,932,259	..	271,434	2,774,043
Lambs ..	84,546	5,118,981	..	23,323	5,226,850
Swine ..	99,635	113,200	30,083	23,466	266,384

Winter Farm-schools.—In addition to the fixtures announced in the *Journal* for April last, courses have been arranged for Westland, at Greymouth, from 22nd to 25th July; and for Marlborough, at Blenheim, from 4th to 8th August.



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THE FORMATION AND CONDUCTING OF DAIRY- HERD-TESTING ASSOCIATIONS.

W. M. SINGLETON, Director of the Dairy Division.

AS recently as the year 1909 dairy-farming in New Zealand was carried on practically without any systematic study of the performance of individual cows. Cows were selected on appearance and milk-flow, fed little beyond ordinary pasture, and mated with bulls lacking known butterfat-record ancestry. The average dairy-farmer was content with his knowledge of his herd, and it was not until the more general use of the Babcock tester that many fallacies were revealed and a keener interest in dairy stock resulted. In August, 1909, our first cow-testing association was organized in the Wairarapa district. The work was carried out by the Dairy Division, with the co-operation of the Dalefield Dairy Company and a number of its milk-suppliers, 815 cows being systematically tested. The following season brought requests for similar assistance from other districts, which resulted in the testing of 4,317 cows. And so the numbers have gone on increasing, until in the 1923-24 season over 150,000 cows, or 12 per cent. of the Dominion's dairy cows, were tested for butterfat yield. Of these, the work for 37,378 cows was carried out by officers of the Dairy Division, and the remainder by privately controlled associations.

Cow-testing forms the key to successful dairying. To ascertain the profits of his labours the dairy-farmer must compare the cost of

running his herd with the value of that herd's output, and the scales and Babcock tester often stand between failure and success. Post-war conditions have reduced the margin between cost of production and market values, until many dairy farms can no longer pay unless stocked with profitable producers. There are, of course, other factors—feed, care, and so forth—but the cow must be worthy of that attention.

THE ASSOCIATION SYSTEM.

The system originally recommended by the Dairy Division, and still very generally in vogue in New Zealand, provides for the weighing and sampling of each milking for two consecutive days in each thirty days. For sampling, a bottle with a capacity of about 4 fluid ounces—known as a "4 oz. milk-sample bottle"—is used. A 1 oz. sample, measured by means of a 1 oz. dipper, is taken from each milking and mixed in the one bottle, thus forming a composite sample. The samples are taken and the milk-weights recorded by the association member. The milk-weights are entered on a form specially provided for the purpose by the Department. The samples are placed in a specially constructed milk-sample box, the weight sheet included, and sent to the testing-depot—usually the dairy factory to which the herd-testing association member is a supplier. The testing officer then tests the samples and enters the result alongside each cow's name in the space set aside for the purpose on the form, which also contains the record of the milk-weights. When this part of the work is completed the record is calculated, and the sheet with the completed results is sent to the herd-owner. Before returning the sample-box to the member, in readiness for the taking of the next samples, the testing officer washes and drains the bottles and adds a sufficient quantity of preservative.

When a herd-testing association is initiated among the suppliers to a large dairy factory it is considered advisable that the membership should not include the suppliers of another company, unless there be some strong reason to the contrary. This avoids difficulty in the prompt receipt of samples at the testing-room, and decreases the likelihood of friction between suppliers. It is often found, however, that suppliers to a number of small or medium-sized factories can support one good association by co-operating, whereas failure might ensue if they ventured separately. In such cases co-operation is advisable.

FORMING THE ASSOCIATION.

Probably the most simple method of arranging the formation of a herd-testing association is by a general resolution at the dairy company's annual meeting. It is considered desirable that an association should be part and parcel of the company's operations, the total cost being a charge against the company's general expenses. The only objection to this method is the possible opposition by suppliers who do not desire their herds tested, and who would therefore be against the increased expenditure necessitated by this work. Even from this point of view, however, there is the fact that herd-improvement means an increased supply to the factory, and a decrease in manufacturing-costs should be the tendency of such a result.

If it is agreed that the cow-testing work should not be carried on under the same organization as the usual factory-work an independent association may be formed. In that case it is reasonable to expect that the dairy company among whose suppliers the association is formed would be agreeable to permit the association the use, free of cost, of its testing-machine, testing-room, and steam.

Another system, though a more costly one, consists in the appointment of an independent testing officer to visit each farm, take the samples, check the milk-weights, and do his own testing and figuring. In this case only one day's milkings are checked and tested, and the number of members is obviously restricted to the number of farms the testing officer is able to visit in the month. Concerning this point of one-day testing, there are some association members who are inclined to consider one day's samples sufficient. The Dairy Division has always advocated the sampling and weighing of each milking for two consecutive days in each thirty-day period. Cows are found to vary a good deal from day to day in both milk and test, and experience has shown that if a cow is down in milk-weight or test one day she is often up the next, and thus the irregularity is counterbalanced.

This also applies, of course, to cows which may test or milk abnormally high on the first day of the testing. When samples from four milkings are mixed in the one composite sample one abnormal test (either higher or lower than the normal) does not have so much influence on the result as would one abnormal milking in the case of only two samples. Were the samples taken over an exact twenty-four hours, tested separately, and figured in conjunction with the weight of the individual milking to which the sample refers (as is the case with the certificate-of-record testing of purebred dairy cows) an abnormal test would not bear so marked an influence. It has to be recognized that a two-day sample is, owing to cost, out of the question if samples are to be taken by an independent testing officer. The system which provides for the employment of such an officer is to be recommended strongly where the owners are not disposed to have the milk weights and samples properly taken by themselves, or at their direction. The system under which the independent testing officer is employed is often the best for overcoming the difficulty presented by the releaser milking-machine.

In the event of an association being conducted independently of the dairy company the following by-laws are suggested as a guide:—

1. Any dairy-farmer supplying this co-operative dairy company will be admitted to membership if he agrees to weigh and sample night and morning for two consecutive days in each testing-period the milk of each and every cow subscribed for test. The number of members may be limited by the committee of management.
2. Members shall provide balances for weighing the milk, a dipper for sampling, a sample-bottle properly numbered for each cow, and a box for holding these bottles.
3. Members shall undertake the delivery of their samples for testing at the factory or station where the testing is done.
4. The testing shall be done by the Babcock method.
5. Any member wilfully returning incorrect weights or samples shall be refused permission to take further part in the work of the association.
6. Each cow once tested shall be counted as a cow for the season.

SAMPLING AND WEIGHING THE MILK.

It is widely recognized that in order to ascertain the yield of dairy cows with absolute accuracy the weighing and sampling of the milk at each milking are essential. Such accuracy, however, is only necessary in the making of official records, and the system is seldom undertaken except with purebred dairy cows. Needless to say, such practice is not considered within the scope of herd-testing association work. Recognizing that dairy-farmers did not demand such accuracy in connection with their individual-cow records, and that very few could be induced to undertake such a task, the Dairy Division in the first place decided to merely ask members of associations to weigh and sample the milk from individual cows for two consecutive days in each thirty-day period. It was further suggested that if cows were in ill health, or otherwise out of their normal condition, such weighing and sampling should be deferred until normal conditions again obtained. Good reliable work can be done in this way, and results have shown that the estimated yield in many instances shows only a narrow variation from the actual yield according to the factory returns. The question of one *versus* two days' sampling and weighing has been treated previously.

Following is a copy of a circular of instructions which is sent by the Dairy Division to members before the first weighing and sampling take place :-

Instructions for Weighing and Sampling at the Farm.

1. The spring balance should be hung in a place which will be most convenient. A plentiful supply of light ensures more accuracy in taking the weights, and also saves time.
2. The blank form (No. 1) for the record of the weights of the several milkings, &c., should be attached to a smooth flat board, and hung near the spring balance. A pencil should be fastened to this board with a string of the necessary length.
3. Immediately after milking, the milk should be poured into the weighing-bucket and sampled at once. The weight should then be recorded, and the milk delivered to the can. One pouring of the milk is sufficient, and enables a representative sample to be taken.
4. Be sure that each sample-bottle bears the number which corresponds to that of the cow.
5. The names of cows should be entered on the No. 1 form in the same order for each period right throughout the season. Farmers should keep a copy of the No. 1 form for the first testing-period, so that they shall know the order in which they have placed their cows. This is important.
6. The preservative is placed in the sample-bottles at the testing-depot, and with the addition of each sample a gentle rotary motion should be given to ensure proper distribution of the preservative.
7. The sample-bottles should always be kept well stoppered. Evaporation of moisture from the samples impairs the accuracy of the test.
8. When the sample-box is on the farm it should be kept under lock and key, and outside the reach of children, as the preservative used is poisonous.
9. As soon as the four samples have been taken, the box should be despatched to the testing-station, and the sheet containing the weights of the milk should be enclosed in the box.
10. If cows are "in heat" or otherwise out of their normal condition the weighing and sampling of their milk should be deferred until they have recovered their normal condition. Such samples could probably be brought to the testing-depot before the testing is finished.

The weighing is done by means of a spring balance of the hook or quadrant type. Good strong balances of assured accuracy should

be used. Weights of milk are usually indicated to half a pound, and the balances used should be graduated accordingly. Members should be careful to deduct the exact tare of the weighing-bucket used. Buckets and tins vary considerably in weight, and it is therefore more satisfactory to keep one particular bucket on the hook during the weighing and sampling period.

SAMPLING-REQUISITES.

Bottles: Four-ounce milk-sample bottles, specially designed for cow-testing association work, and provided with a suitable cork, are easily procurable. The four samples should fill these bottles to within $\frac{1}{8}$ in. of the cork. If filled too full, difficulty is experienced in getting the cream thoroughly incorporated, thus affecting the accuracy of the test. These bottles are provided with brass bands around the neck, and on this band is stamped the number which corresponds to the cow which has been given the same number. For the purposes of compilation of testing returns cows are known by numbers and not names. If the cow's name were also put on the bottle it would probably save time in sampling, and avoid possible errors by putting the sample in the wrong test-bottle. If the papers bearing these names are gummed on the bottle, and coated over with two applications of white shellac, they should stick very well despite the washing.

Preservative: For keeping milk-samples in good condition until tested, powdered bichromate of potash is usually used. About as much as will cover a threepenny-piece is sufficient. The same preservative in tablet form is very convenient, though much more costly than the powder. In warm weather, or when the samples have to be kept some time before testing, a mixture of one part of corrosive sublimate to two parts of bichromate of potash has been found effective. Formalin in liquid form is sometimes used, but its use is not recommended. It has two principal disadvantages: First, milk treated with formalin does not always mix satisfactorily with the acid used in the process of testing; and, second, formalin is colourless, and thus it cannot be told at sight whether or not this preservative has been added.

Sampling-dipper: The sampling-dipper should be of such capacity that four samplings will fill the bottle to within about $\frac{1}{8}$ in. of the cork. A reasonably short handle contributes to surer work.

Milk-sample box: The box should be made of fairly strong material, so as to be serviceable for some years. Those in use are rectangular in shape, the dimensions varying according to the number of bottles they are required to hold. One-inch boards, dressed, make a good serviceable box. Provision should be made against the splitting of the lid of the box. It is also necessary to provide each box with a lock to secure the bottles, which contain poisonous preservative, from children.

REQUISITES FOR THE TESTING-ROOM.

Provided the dairy company permits the association to use its testing-machine, testing-room, and steam, the other expense, with the exception of test-bottles, will not be large.

It has been found that the provision of sufficient test-bottles to hold the samples tested in one day facilitates the work. The reason is that at times it is more convenient to obtain a supply of steam in the forenoon, and in such cases the testing officer can do his sampling in the afternoon, and then keep the testing-machine going almost continually the following morning. The fat-percentages can be read off from one lot of bottles while another lot is being whirled. With a convenient room, one man can in this way run through over two hundred samples a day, provided he does not do the washing of the sample-bottles.

A list of the requisites necessary, together with prices, would be somewhat as follows:—

	£	s.	d.
Two gross of Babcock milk-test bottles	21	12	0
Packing same	0	2	6
2 lb. powdered bichromate of potash	0	5	0
One acid-burette (25 charge)	1	15	0
One acid-measure (17.5 c.c.)	0	1	3
One pair dividers	0	1	6
Six pipettes (tested)	0	10	0
Three dairy-thermometers (tested)	0	10	0
Twelve blocks (with 24 holes)	1	16	0
Three boards (with $\frac{5}{8}$ in. holes)	0	4	6
Buckets, trays, dipper, &c (say)	2	0	0
Two cases sulphuric acid (244 lb at 4d.)	4	1	4
Total	£32	19	1

A number of these items are usually found in the average factory testing-room. Prices are based on the average of best quotations at time of writing, but can only be taken as a guide.

MEMBER'S OUTFIT.

The items which the association member is asked to furnish are sample-bottles with numbered brass bands (one for each cow), a spring balance, a sampling-dipper, and a box in which to deliver the samples to the testing-depot. For a herd of forty cows the approximate cost (excluding any freight) will be as follows: Forty bottles with brass bands, at, say, 4½d., 15s.; one sampling-dipper, 1s.; one spring balance (strong and tested), 8s.; one box for samples, say, 14s.: a total of £1 18s., or less than 1s. per cow, for the first year, and nothing additional for succeeding years save for replacement of breakages. With smaller herds the cost per cow would, of course, be slightly higher, since the price of the balance and dipper would be divided among the smaller number.

FORMS USED IN RECORDING HERD-TESTING RETURNS.

Three forms are in use by the Dairy Division in connection with this work, known as forms No. 1, No. 2, and No. 3 respectively. Reduced facsimiles of these are here presented.

Form No. 1 is for use at the dairy farm. It provides for the name and address of the member, the dates on which the weighings and samples are taken, the name, breed, age, and date of last calf of each cow, and the weight of each milking during the two-day

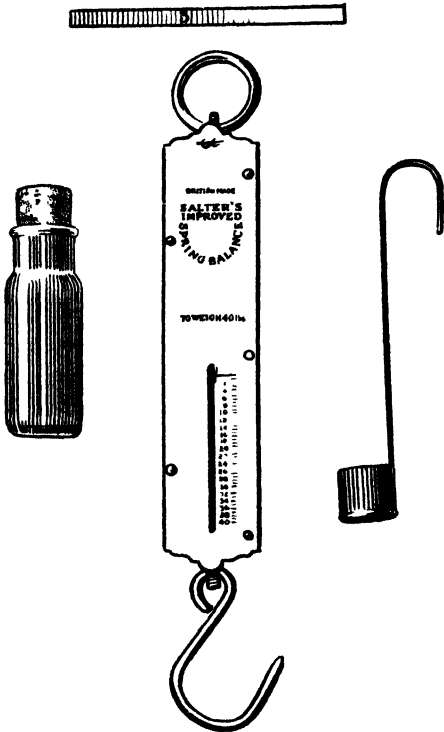


FIG. 1. MEMBER'S OUTFIT: SPRING BALANCE, MILK-SAMPLE BOTTLE, BRASS BAND FOR BOTTLE, AND SAMPLE DIPPER

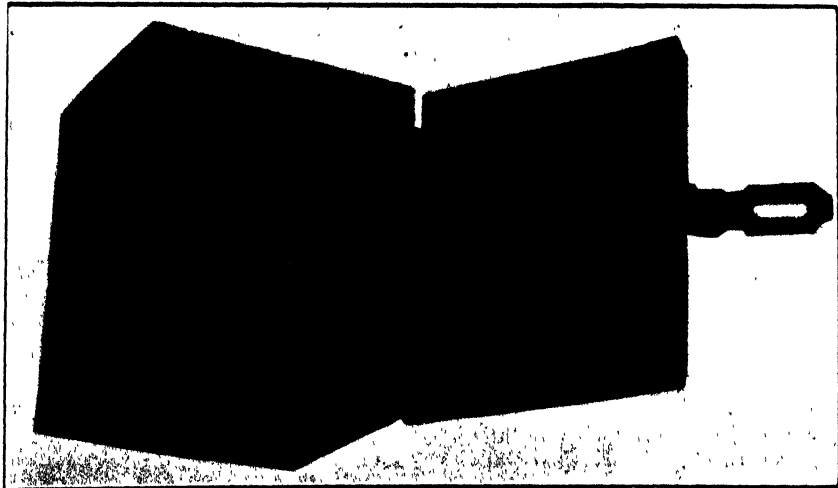


FIG. 2. MEMBER'S MILK-SAMPLE BOX.

sampling-period. These particulars are inserted in each period by the association member, and when complete in this respect the form is enclosed in the box with the samples and forwarded to the testing-depot. This form provides not only for the individual records for each cow for the period, but also for the yield from the date of calving to the close of the period of the test. As the samples are tested, the testing officer enters the result against each cow's number in the space provided for the purpose. This operation completed, the form is passed on to the officer appointed to do the computing of the yields, who fills in the remaining columns—namely, calculated milk for the period; calculated pounds of fat for the period; pounds fat since calving; days in milk since calving; and, at the head of the form, the herd-number, the period-number, and the period closing-date. The form provides for thirty cows, and is numbered accordingly. The Dairy Division also issues a similar form numbered from thirty-one to sixty, to accommodate the returns for larger herds. At the foot of every No. 1 form is space for entering the average yield of milk and fat for the herd for the period, the average test, and the number of cows represented in such average; also, similar particulars for the whole association for the period, so that the member may compare his average cow with the average cow in his association.

Form No. 2 is designed to serve as a permanent record for the office or clerical officer of the herd-testing association. The sheet provides for eleven thirty-day periods. At the head of the form is entered the name of the association, the season, and the name, address, and herd-number of the member. At the head of each "Period" column is a space for the period closing-date, and at the right of the form is entered the name of each cow, the age, breed, and date of calving—this information being copied from the member's first No. 1 sheet on which the cow appears. The "Period" columns themselves exactly coincide with the columns for similar information on the No. 1 form, so that the figures may be transferred by means of carbon paper. Excepting for the first period, the period returns for fat and days are added to the results at the end of the previous period—this, as just stated, being copied on to the No. 2 form from the No. 1 by means of carbon paper. This is the object of running the columns from right to left instead of in the orthodox direction. When the No. 2 sheet is placed over the No. 1 in the proper position the previous period figures are next at hand, and thus convenient for mental computation. At the foot of the form is space for the herd average for the season. This form, similar to form No. 1, provides for thirty cows, with a continuation sheet running from 31 to 60.

Form No. 3 is purely for office record and information. It gives a summary of the production of the various herds in the association for the period. To those associations which will supply the information included on this form to the Director of the Dairy Division for each period, and at the end of the season an annual summary on a similar basis, the Division will undertake to provide, free of cost, a requisite supply of forms Nos. 1, 2, and 3. Form No. 3 provides for forty herds.

FORM No. 1 *Kopurata* Cow-testing Association Period No. *4*, ending *5th Nov.*, 1923 Herd No. *6*.
 Name: *John Ball* Address: *Kopurata* Dates of weighings: *Nov* and *21st Oct.* 1923.

No	Name of Cow	Breed	Age	Date of Calving	Two Days' Weights A. W.	P. W.	Total Two Days	Calculated Milk for Period	Test	Lb. Fat.*	Days in Milk.
1	<i>Dorothea</i>				<i>14</i>	<i>12</i>	<i>50$\frac{1}{2}$</i>	<i>765</i>	<i>60</i>	<i>38.25</i>	<i>227</i>
2	<i>Judy</i>				<i>11</i>	<i>10$\frac{1}{2}$</i>	<i>42</i>	<i>630</i>	<i>46</i>	<i>28.91</i>	<i>169</i>
3	<i>Lucy</i>				<i>8$\frac{1}{2}$</i>	<i>7$\frac{1}{2}$</i>	<i>33</i>	<i>495</i>	<i>36</i>	<i>27.22</i>	<i>152</i>
4	<i>Lily (replacing Agnes)</i>	<i>Grade Jersey</i>	<i>Native</i>	<i>28-7-23</i>	<i>17$\frac{1}{2}$</i>	<i>13$\frac{1}{2}$</i>	<i>61$\frac{1}{2}$</i>	<i>930</i>	<i>48</i>	<i>44.64</i>	<i>100</i>
5	<i>Myra</i>				<i>14$\frac{1}{2}$</i>	<i>11$\frac{1}{2}$</i>	<i>51$\frac{1}{2}$</i>	<i>765</i>	<i>50</i>	<i>38.25</i>	<i>66</i>
6	<i>Ridget</i>	<i>Jersey Cross</i>	<i>6</i>	<i>1-4-23</i>	<i>12$\frac{1}{2}$</i>	<i>10</i>	<i>(22$\frac{1}{2}$)</i>	<i>675</i>	<i>58</i>	<i>35.77</i>	<i>106</i>
7	<i>Note: Cows numbers 4 and 6 were recently brought into sale.</i>										
8							<i>Total</i>	<i>4260</i>		<i>213.61</i>	
9											
10											

Herd Average *6* Cows *718* lb Milk *3560* lb Fat *50 $\frac{1}{2}$* Average test
 Association Average *123* Cows *931* lb Milk *3771* lb Fat *40 $\frac{1}{4}$* Average test

* In the column headed "Lb. Fat" give the lbs. fat actually
 poured in cream to the upper division and the lbs. fat
 skimming to the lower division.

FIG. 3. FORM NO. 1.

The actual form has space for thirty cows.

(Fig. 4.—Form No. 2—in next page.)

COW-TESTING FORM No. 3.

14 $\frac{1}{2}$ $\frac{D}{32}$.

Kopurata Cow-testing Association. Period ending *5th Nov.*, 1923.

Herd No.	No. of Cows	HERD AVERAGES			HIGHEST INDIVIDUAL YIELD CALCULATED FOR MONTH			LOWEST INDIVIDUAL YIELD CALCULATED FOR MONTH		
		Milk, lb	Test	Fat, lb	Milk, lb	Test	Fat, lb	Milk, lb	Test	Fat, lb
1	20	1042	4.9	51.15	1485	4.5	66.82	885	5.5	48.67
2	12	934	4.7	43.71	1680	4.0	67.20	915	4.1	37.51
3	27	1011	3.4	35.38	1235	4.2	56.07	555	4.0	22.20
4	22	962	4.8	39.39	1200	4.9	58.80	420	2.7	15.54
5	26	755	3.6	27.02	1230	4.1	50.43	660	2.0	13.20
6	6	710	5.0	35.60	920	4.8	44.64	620	4.6	28.98
7										
8	123	114531		4629.28	(Association Totals)					
9		931	4.0	37.71	(Association Average)					
10										

FIG. 5. FORM NO. 3.

The actual form has space for forty herds.

SUGGESTIONS FOR PERSONS ENGAGED IN THE COMPILATION OF HERD-TESTING RETURNS.

Persons undertaking the compilation of herd-testing returns, and not previously experienced in this work, sometimes find a little trouble in getting a grip of the system. To help them, and also with a view to uniformity in the system adopted by the clerical officers of the various herd-testing associations in the Dominion, the following detailed guide has been prepared:—

Name and Address of Member.—Members should supply name and full postal address on each return throughout the year. This will avoid returns going astray as the result of being insufficiently addressed.

Sampling-dates and Dates of Calving.—Members should supply dates of sampling on all returns, and should also indicate exact date of calving on the sheet on which cows appear for the first time.

Period Closing-dates.—On receipt of the first sheets for the season the period closing-dates must be selected. An average is taken of the sampling-dates, and to this date fifteen days are added, thus giving the most suitable closing-date. Due regard, however, must be given to subsequent sampling-dates, in case these may be set earlier or later than in the case of the first period. The samples should be taken as early as possible at the middle of each period throughout the season. The closing-date of the first period being determined, subsequent period closing-dates are set at equal intervals of thirty days.

Names of Cows.—Cows must be kept to same numbers as when first submitted. It is considered wise to stamp all sheets for the first three periods or so as follows: "Cows must be kept to same number throughout season." In cases where cows are sold, withdrawn, &c., the blank may be filled by a freshly calved cow. When returns are received they should be checked off with the particulars on the No. 2 form to see that cows are in the same order.

Breed and Age.—Although we have not insisted on these details being supplied, yet one request should be made where such particulars are not given. Not only is the breed a guide to the identity of the cow, but it is often of interest for statistical purposes.

Date of Calving.—Where only the month of calving can be given, days since calving to the end of the first period should be calculated from the middle of the month, thus making the possible error a minimum. It is the practice of the Dairy Division's head office to stamp the first three or so periods as follows: "Please insert calving-dates for cows freshening since last sampling." It has been found that members repeatedly overlook supplying this information, and also the breed and age of new cows. Where no calving-dates are supplied a copy of all figures for the period for such cows should be kept, and the calving dates requested, instead of holding the member's return until his next No. 1 form is to hand.

Owner's Two Days' Weights.—Weights for each cow should be kept within the heavy lines. It should be insisted that members indicate whether weights are for one or two days, as from the figures supplied it is not always obvious which is the case, especially when it is late in the season and the milk-yield is low. Some members have a tendency to supply only one day's weights even in the flush of the season. This practice should be discouraged, as it does not tend to greatest accuracy. Weights should be given to the nearest half-pound.

Calculated Milk for the Period.—This should be found by multiplying the two days' weights by fifteen, or the one day's weights by thirty. If there is a fraction in the owner's total this should be taken as the next whole pound where it is a half or over. A suitable table can be prepared in connection with calculation of period milk-production, by working out the required milk for all two days' weights from 1 lb. to, say, 100 lb. Where milk-weights are missed for one period but a test is supplied, an average of the weights for the preceding and following periods should be taken.

Tests.—Where tests are not taken, or are not given on account of a broken sample-bottle, spilt or sour samples, &c., they should be averaged for between the previous and the following period tests, and the returns compiled accordingly. Also, abnormally high or low tests should be looked for, and deleted in favour of an average test. Averaged tests should be indicated in red ink.

Period Fat—Where both tests and the milk-weights are omitted for one period the fat should be averaged between the fat from the previous and following periods, but the practice of averaging should not apply generally where cows miss two periods, as the possibility of error might be large. Oldham tables facilitate the figuring of period fat.

Days in Milk.—For the first period the number of days from calving to the period closing-date should be counted—excluding the day of calving but including the day of closing of the period. In cases where the number exceeds 100 no figures for fat since calving should be given, and the words "Too long" inserted in the "fat" column. Premature calving is accepted for clerical purposes as an ordinary calving.

Fat since Calving.—Fat since calving for the first period is figured on the proportion basis from period-fat figures. Fat for each period following is added to the fat from calving to the end of the previous period, and the results transferred direct to the No. 2 form by means of carbon paper.

Period Herd Average—This is based on the milk, test, and fat for the period only, and should include all cows whether "Too long" or otherwise, and irrespective of age. The columns for milk and fat for the period are totalled, and each total divided by the number of cows. To ascertain the average test for the herd, divide the total milk into the total fat.

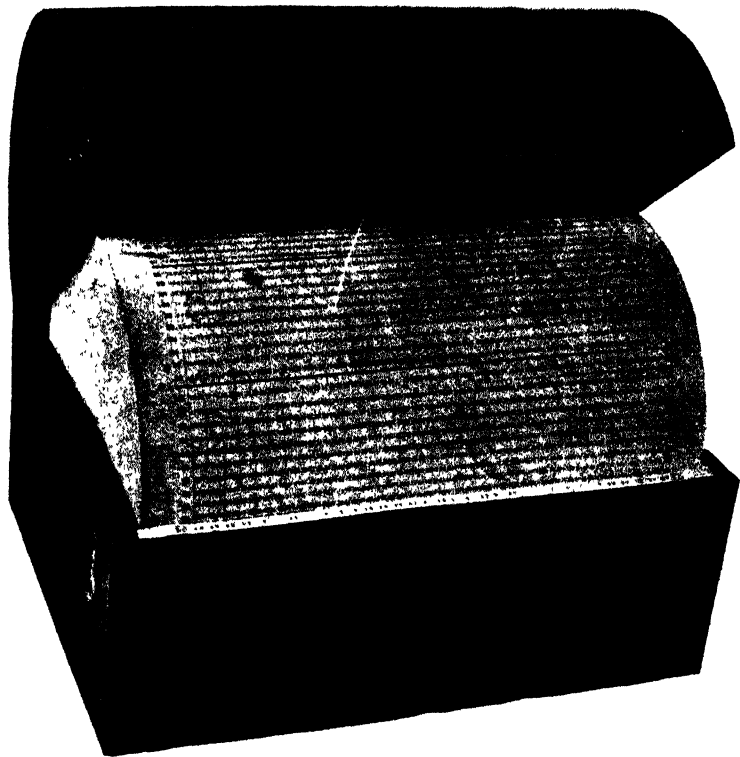


FIG. 7. OLDHAM'S HERD-TEST CALCULATING-DEVICE.

For calculating the butterfat for the period the cylinder is revolved until the amount of milk for the two days (shown on extreme left of table) is brought opposite the test row. The amount of butterfat is then given directly opposite the test with which the cow is credited. Device patented by Mr. G. H. Oldham, Hamilton.

Period Summary.—This is entered on form No. 3, and the association period average run out from the period herd-totals. The average milk, the average fat, and the average test for the association should be indicated on each member's sheet in the space provided, in order that he may compare the production of his average cow with the production of the average cow for the association as a whole. The average test is derived by dividing the total period milk for the association into the total period fat for the association. Two-year-olds are included in this summary so far as period averages are concerned. In selecting the lowest yield for the herd two-year-olds should be omitted, but a two-year-old may be the highest cow.

Transferring Figures from Form No. 1 to No. 2.—A strip of carbon paper, sufficiently wide to cover the "Period" column, is placed over such column of the No. 2 form, and the No. 1 form placed over this, so that the columns on both sheets coincide. Care should be taken that the first figure of the fat and day does not fall on the vertical lines on the No. 2 sheet, as in cases where the figure is 1 this sometimes coincides with the line, and in the next period it is omitted through being indistinct, thus dropping either 100 lb fat or 100 days. Only those cows tested twice or more are, as a rule, charged for. Where a cow dies, or is sold or culled, her place on the form may be filled by a new cow. Care must be taken to bracket the one cow's figures from those of the other in some distinctive manner. In adding the herd averages at the close of the season no figures should be omitted in such cases as the above, provided, of course, that the cow has been in milk 100 days and over. Where a cow finishes one lactation period and commences another during the normal season, the end of the first period should be enclosed in a red bracket, and the second continued in the ordinary way.

Drying-off Dates.—As the season advances all members should be circularized regarding supplying drying-off dates. The "drying-off" date should be entered on the No. 2 form, and the fat calculated to that date. The final figures may be entered in red ink on form No. 2, as they are then more easily detected when adding the totals for the herd. When drying-off dates are received, sometimes the figures to the end of the previous period have to be cut back on account of cows having dried off before the closing of that period, drying-off dates being notified after such period return was posted out. In others some days have to be added on, and the fat calculated from the previous period fat on the proportion basis, and in a similar manner as for the first period.

Annual Summary.—The last figures for each cow are totalled, and the average cow found. Two-year-olds are included, but no cows in milk less than 100 days or more than 365 days. All records above 365 days should be cut back to 365 days for purposes of annual summary. The highest cow may be a two-year-old, but the lowest cow is to be selected exclusive of two-year-olds. The production of the average cow of each association is obtained by dividing the total fat and total days for the association by the total number of cows, as is done in the case of herd figures. Figures for the average association cow should not be obtained by adding the herd averages and dividing by the number of herds, since this does not give an accurate result. This is because the individual herd averages are representative of different numbers of cows, and therefore do not give a correct result when added and divided by the number of herds. The same remarks apply to the monthly summary.

This guide is issued to those concerned in circular form, appended to which is (1) a blank copy of a circular report to be sent to association members, giving the results of the season's work; (2) a table for calculation of milk for period; and (3) a specimen table for calculating days in milk as used in the head office of the Dairy Division.

NOTE.—In connection with the foregoing matter the writer desires to acknowledge the cordial assistance given by Mr. H. G. Philpott, of the Dairy Division office, who has been connected with the testing-work almost since its commencement in New Zealand. His suggestions with regard to forms 1 and 2 referred to, and to improved methods of compiling the records, have been of much value.

THE BUSH-SICKNESS INVESTIGATION.

LABORATORY WORK AND RESULTS.

(Concluded.)

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

COMPOSITION OF PASTURE PLANTS—continued.

THE amount of iron in pasture plants varies with the season and the age of the portion analysed, that portion of the plant grown in spring and summer containing least iron, and that portion which may be collected in late summer and autumn containing most iron. The gradual increase in the iron content is well shown in the examples given in last month's *Journal*. The following analyses of grasses grown on the bush-sick country show that their content of iron may sink below even the small amounts quoted for clovers:—

Table 8. Grasses from Bush-sick Country.

Sample No.	Month collected.	Locality.	Species.	Manuring.	Percentage of Iron on Ash.	Remarks.
D 1257/1	Nov.	Mamaku ..	Cocksfoot ..	Slag and super	0.050	Just coming into flower.
D 1257/5	"	" ..	" ..	Unmanured	0.050	
C 196	Dec	Te Pu ..	Foxtail ..	"	0.130	In flower
C 195	"	" ..	Cocksfoot ..	"	0.113	"
C 1316/5	"	Mamaku ..	" ..	"	0.120	
C 1316/6	"	" ..	" ..	"	0.110	
C 1316/7	"	" ..	" ..	Limed ..	0.102	
C 1316/11	"	" ..	" ..	"	0.080	
C 1316/12	"	" ..	" ..	"	0.067	
C 1316/18	"	Litchfield	Grass ..	"	0.080	
D 33/9	Jan.	Te Pu ..	Cocksfoot ..	"	0.112	
D 33/12	"	Mamaku ..	" ..	Unmanured	0.073	
D 33/15	"	" ..	" ..	Control ..	0.080	
D 33/17	"	" ..	" ..	Super and iron	0.120	
D 88/2	"	Te Pu ..	Pasture ..	Slag and iron	0.091	Short, mixed feed.
D 88/3	"	" ..	" ..	Super ..	0.140	
D 88/4	"	" ..	" ..	Lime ..	0.140	
D 88/5	"	" ..	" ..	Unmanured	0.134	
D 88/6	"	Mamaku ..	Cocksfoot ..	Iron ..	0.103	
D 88/13	"	" ..	Green oats ..	Phosphates..	0.098	

Analyses of the samples of hays recently collected from the bush-sick area show an iron content of from 0.08 to 0.13 per cent. of iron (Fe) on the ash.

Dr. J. B. Orr, of the Rowett Research Institute, Aberdeen, gives the following figures for lucerne hay, red-clover hay, and timothy hay:—

	Ash. Per Cent.	Iron Oxide (Fe ₂ O ₃) on Hay. Per Cent.	Iron (Fe) calculated on Ash. Per Cent.
Lucerne ..	8.6	0.17	1.4
Red clover ..	7.1	0.07	0.7
Timothy..	4.9	0.04	0.6

Comparing these figures with those of samples from the bush-sick country given in last month's *Journal* and the grass and hay samples given above, it will be seen that these latter samples are very deficient in iron. With regard to New-Zealand-grown cocksfoot and other grasses, it has also been found that those grown outside the pumice district have, generally speaking, a far higher iron content than those growing on bush-sick lands. Hall, in "The Feeding of Crops and Stock," 1911, p. 4, gives the amount of iron in meadow-grass as 0.007 per cent., or nearly three times the quantity found in Mamaku pasture.

AMOUNT OF FOOD IRON REQUIRED BY ANIMALS.

The amount of food iron, as distinct from medicinal iron, which an animal requires daily must now be considered. By "food iron" is meant the iron present in the natural food of the animal; it has a value greatly differing from that of any iron given in medicinal form, which, although such may be absorbed, the animal is thought not to be able to utilize it in the same way as it does the food iron in the making of blood constituents and other cells. The proof that the animal requires a greater amount of food iron than that present in the bush-sick pasture is the most difficult link to forge in the chain of evidence with which it has been sought to fasten cause to effect.

Sherman ("Chemistry of Food and Nutrition," 1911), in discussing the iron-requirements of the human body, concludes that for the average man under favourable conditions a daily allowance of 10 to 12 milligrams of food iron should suffice. He suggests that the female of the species under certain conditions may require more, and growing children more in proportion to their weight, than does the male.

Dr. Orr states in the "Importance of Mineral Matter in Nutrition" that the best guide to the amounts and proportions of inorganic or mineral foods required by animals is to be found in the composition of the milk-ash of the species. Sheep and pigs double their weight in about the same time, and the mother's milk contains nine times as much iron as human milk; while a calf, which takes four or five times the period to double its weight, receives less than one-quarter of the amount of iron in its milk; and a foal, taking six times the period that a pig takes to double its weight, receives milk which only contains one-ninth of the quantity. Thus the faster a species grows the more iron it is found to receive in its milk food. In practice it is found that the liability of animals to suffer from diseases of malnutrition due to lack of mineral food is greatest in those species that grow fastest. This information is well summarized in the table given by Dr. Orr (modified). (There seems to be the widest discrepancy in the figures given by various authors on the subject of the iron content of milk.)

Species.	Time taken to double Weight. Days.			Proportion of Iron in Milk. (Fe.)
Human	180	0.00007
Horse	60	0.00007
Ox	47	0.00014
Goat	22	?
Pig	10 (14)	0.00063
Sheep	15	0.00079

Abderhalden (*Journal of Physiological Chemistry*, vol. 27, p. 594) gives the time of a sheep as similar to that of a pig. The figure (14) for the pig is given on his authority.

Evidently the food-iron requirements of the different species vary considerably. It seems a fair assumption that a cattle beast would require very much more food iron per unit of body-weight than does the human species. It also seems certain that one cannot admit the possibility of all the food iron being assimilable by the animal. Kellner ("Scientific Feeding of Animals," p. 98) suggests that from two to three times as much mineral food must be given as can be stored in the body. In the case of the mineral constituents—lime and phosphoric acid—it is well known that only about 50 per cent. of these food constituents can be absorbed and retained. It is reasonable to assume that of the total amount present only a part of the food iron can be assimilated.

To make this matter clear one may quote the instance given by McGowan and Crichton in a paper "On the Effect of Deficiency of Iron in the Diet of Pigs" (*Biochemical Journal*, vol. 17, 1923, No. 2). According to these authors, pigs suffered from iron-deficiency when the mothers were fed on the following diet per sow per day :—

	lb.	Percentage of Iron (Fe).	Iron (Fe). Gram.
Fish-meal	1 $\frac{1}{2}$	..	..
White sharps	2 $\frac{1}{2}$	0.002	0.020
Bran	1 $\frac{1}{4}$	0.030	0.145
Bruised oats	1 $\frac{1}{4}$	0.040	0.220
Potatoes	8	0.010	0.360
Turnips	10	0.007	0.317
Treacle	$\frac{1}{2}$	..	..
Total .. ..	..	..	1.068

NOTE.—The iron in fish-meal and treacle is small enough to be negligible.

When plenty of iron oxide was added to this diet the pigs recovered their normal health. It will be seen that an amount of at least 1,068 milligrams of iron per sow per day was consumed.

In the case of the spring and early summer grass, only about 0.0025 per cent. of iron would be present in the pasture, so that 100 lb., the approximate amount that a cow eats daily, would contain 1,134 milligrams of iron. Comparing the relative sizes of the cow and the sow there seems to be evidence here that 1,134 milligrams of total food iron would be insufficient for the cow.

Regarding the requirements of sheep, the milk of the ewe and of the sow is comparable. Both have the same ash content and iron content, and both have a similar rate of growth: hence it is reasonable to assume that the iron requirement may be similar. The ruminant sheep may be more difficult to satisfy in the quality of the food iron; and whereas iron oxide, cinders, and other inorganic sources of iron may be used in the case of the pig, such may not be assimilable by the sheep, which may require its supply in the form present in vegetable life. Mineral foods given as such are more readily assimilated by pigs than by some domestic ruminants. Experiments in the United States have proved the efficacy of raw mineral phosphate in supplying the bone-making elements when these were deficient in pigs' food, but

mineral phosphates were found to be not effective in the case of cattle in South Africa suffering from phosphate deficiency. For ruminants the mineral foods are no doubt best passed through the pasture by top-dressing or otherwise manuring the natural fodder with mineral fertilizers.

The horse, being of much slower growth than any of the ruminants, taking four times as long as the sheep to double its weight, and having a milk which contains only one-ninth the quantity of iron, must have a very low iron-requirement, and this is probably the reason why horses never become bush-sick on the same pasture which produces the disease in sheep and cattle. It is possible also that the horse, with its entirely different system of digestion, has a more economical way of dealing with the small supply of food iron in pasture growing on sick country.

The study of iron as an element in the nutrition of animals has been neglected in a remarkable manner. It seems to have been taken for granted that so little iron is required that it is never deficient, especially in green foods, notwithstanding the well-known fact that plants comprising the pasture vary in composition according to the composition of the soil upon which they are grown and the manuring which has been applied. Indeed, the range of variation in composition of different individuals of the same species of plant under different environment may be greater than that of different species in the same environment. It is known that the mineral elements other than lime and phosphoric acid are required by animals in smaller amounts than are the latter, but the actual requirements are *not even approximately known*. Much work requires to be done to determine the requirements for even such a necessary element as iron. Owing, however, to this lack of exact knowledge regarding the iron-requirement of ruminants one must rely for a decision most largely on a comparison of the chemical composition of the pasture, of the diseased animal, and of the soil with similar samples from normal districts; on the kind of manuring necessary to transform unhealthy land into healthy country; also on certain pathological conditions or symptoms and *post-mortem* appearances which are known to be characteristic of iron starvation; and, finally, on the medicinal treatment by which animals may be restored to perfect health without changing their food. From this evidence, which has been presented in detail, *one can only arrive at the conclusion that a deficiency of iron in the pasture commonly grown in the affected area is the cause of bush sickness.*

Here the writer would beg the indulgence of the reader to explain a remark regarding sulphur in the article of this series published in the *Journal* for May last (page 303), which has been misunderstood. The writer has been misquoted, and the suggestion that bush sickness is caused by excess of sulphur has been attributed to him, which he now takes the opportunity to repudiate. The paragraph in question was reproduced from the *Journal* for November, 1911, page 308, to explain the formation of pumice. The reference to sulphur is intended to indicate the necessity for the weathering or oxidizing of rock before it can become a suitable medium for plant-growth. So far from excess of sulphur being present in the soil in question, the exact opposite is the case, for some farmed pumice soils contain extremely small

quantities. Sulphur is one of those elements, like iron, essential for the growth of plants and animals, and it is lost from the soil in quantity by leaching. It is, however, also replenished by the rainfall containing sea-spray, which when dried up may be carried long distances inland, calcium sulphate being one of the chief salts of sea-water. Such experiments as have been performed on the sulphur content of New Zealand rain go to show that the amount received per acre is of the same order that experiments in other countries denote is received there. Superphosphate is one of the few artificial manures which contain sulphur as calcium sulphate in quantity, and the influence on crop-growth of this constituent has not yet met with the investigation it deserves. All cruciferous crops, such as turnips, benefit by sulphur, and the superiority of superphosphate over other phosphates for these and other sulphur-demanding crops may be due partly to its sulphur content. Phosphates other than superphosphate, such as Pacific islands phosphate and basic slag, contain so little sulphur that it is negligible. Some of the lower-grade phosphates contain an appreciable amount of calcium sulphate. It is considered that foodstuffs usually contain sufficient sulphur for the animal.

The slow-poison hypothesis was, it is hoped, sufficiently disposed of in the June *Journal*, page 382.

If the matter is one of simple deficiency, why, it may be asked, can the animal not eat more food and so make up for the deficiency in a normal manner, especially since iron is one of those food constituents which may be stored up and are not needed from day to day in balanced ration like protein and carbohydrates? But here the extreme bulkiness of a ruminant's natural fodder comes into play as an adverse factor, even the capacity of an ox being limited. If it requires only one-fifth more iron, can it eat another 20 lb. a day of pasture? And, if it can, will it do so? There may be other factors, such as palatableness, affecting the necessity for eating more. The chances are that an animal getting into an abnormal condition through receiving abnormal food is not likely to be so attracted by it as to eat more—rather will the reverse be the case. One would assume, however, that if the iron-starvation theory be true, wilted grass which has been cut and has lost a considerable portion of the 75 per cent. or more of water which is present in ordinary pasture, if fed to stock, would not only permit of greater consumption and keep them healthy, but would enable them to put on more condition if the fodder were fed in greater quantity. The assimilability of the iron may, of course, be altered by drying the grass, as in haymaking; but, obviously, other things being equal, hay and ensilage should be less likely to cause bush sickness than the green pasture from which it was made, and this aspect is worthy of further investigation.

SOME RECENT WORK BEARING ON IRON DEFICIENCY.

Cotton-seed poisoning or injury is a condition of animals in America of great economic importance. It is attributed to the feeding of cotton-seed meal, and has been variously referred (*Biochemical Journal*, 1924, No. 1) to (1) a poisonous compound of phosphoric acid, (2) an active principle, "gossypol," and (3) dietary deficiency. McGowan and Crichton attributed it, after experimenting with pigs, to iron

deficiency, and call attention to the similarity of the symptoms to those of "wet" beriberi in human beings. They found that iron oxide had a specially beneficial effect in preventing symptoms from arising.

Professor T. B. Wood, in the May, 1924, *Journal of the Ministry of Agriculture*, page 129, states that the importance of the ash constituents of the diet on the growth and development and especially the health of animals has never received the attention it deserves, and in Great Britain has scarcely been touched. Already Dr. Orr and his staff have clearly demonstrated that an inadequate supply of ash constituents produces an immediate and direct effect on the well-being of animals, comparable with the effect of deficiency of vitamins, for which it is frequently mistaken.

In North Britain there exists a malnutrition disease in sheep variously known as "pining," "vinquish," and "daising." This manifests itself as a progressive emaciation when the sheep are grazing on summer pasture, chiefly in certain farms on the Cheviots. If not removed in time the mortality is high. The *post-mortem* examination shows nothing characteristic of disease, the only appearance being one of extreme emaciation and bloodlessness. The only known remedy is to change the sheep to healthy pastures, when they recover. The symptoms shown by living sheep—breathlessness, weakness, bloodlessness, discharge from the eyes which mats the hair of the face, the fleece hard, dry, and staring, and dwindling belly—strongly suggest that pining and bush sickness are similar if not identical diseases caused by iron starvation. The trouble on the Cheviots has been recognized since 1821, when Hogg, the Ettrick Shepherd, published his classic account of the disease, the cause of which has not yet been discovered. The present writer quotes this instance to show that it takes some time to elucidate obscure nutrition diseases in ruminants, even in highly advanced centres of civilization.

The writer has never entertained for one moment the idea that lack of vitamins could be the cause of bush sickness, although such a theory, suggested by others, would be an easy way out of the difficulty.

THE IRON-STARVATION THEORY.

The writer trusts that with the evidence he has been able to set forth in the continuous series of articles beginning with that in the April number of the *Journal* and ending with this issue, the hypothesis he first publicly suggested in the *Journal* for August, 1912, page 123, may now reasonably be referred to as a theory. The writer there stated: "About eight years ago I made analyses of bush-sick animals' blood, and found it extremely deficient in iron. Subsequent tests confirmed those analyses; this, together with analyses of soils and grasses, hinted that a deficiency of assimilable iron in the food might be the cause of the sickness. This suggested the application of iron compounds to the soil as a possible remedy. When therefore asked to suggest a series of schemes for top-dressing the pastures of the affected country, iron sulphate was recommended by me for two farms situated widely apart. It is significant that of all the substances experimented with, iron sulphate applied alone to pasture has been most successful in enabling

sheep (the animal most susceptible to the sickness) to be kept healthy over a period of eighteen months . . . Should future research establish the 'iron-starvation' hypothesis as a theory, it will open a most interesting field for experiment as to the cheapest method by which the remedy may be applied."

Iron sulphate, however, may be too soluble a substance to be suitable for universal application; it is expensive, and has other drawbacks. One other iron compound that has been tried as a dressing for soils is spent oxide from gasworks, containing nitrogen and sulphur compounds. This had a much better effect in producing pasture which enabled sheep to be kept healthy, but the general effect was to decrease the food value of the pasture owing to crowding out of the clovers, which eventually disappeared, probably due to the nitrogenous compounds. Parapara iron, an hydrated oxide, is suggested in the above-quoted *Journal* article (August, 1912) as a source of the needful iron. Being insoluble in pure water, it is not likely to affect the botanical composition of the pasture injuriously, and it might be found to give good results in conjunction with phosphatic manures. Ever since this date (1912) iron deficiency has been the guiding light by which it has been sought to further elucidate the correct treatment of bush-sick lands and animals, a light which has never failed to penetrate obscurity when it seemed most dense.

It is now advisable that the misleading term "bush sickness" should disappear, and be supplanted by the name "iron starvation." The adoption of such a name would do much to bring, if not correct treatment, at least adequate general recognition of the cause of this diet-deficiency disease.

The methods by which iron-hungry pumice lands should be improved are: (1) Appropriate mineral manuring; (2) green-manuring, and, where practicable, application of other organic manures; (3) compaction by rolling; (4) application, where practicable, of any available deposit of greater clay or iron content. The mineral manuring should aim at supplying iron and phosphates. Basic slag, which contains a considerable amount of iron (from 15 to 23 per cent. of oxides), is alkaline, and not so efficacious as when applied with an equal amount of superphosphate. This mixed dressing is found to give the best results on Mamaku pasture. Potash is already present in quantity in most pumice soils. Green-manuring should be practised, and, where available, any organic manures (stable, pig, or cow manure) which will fill up the interstices in this too porous soil and assist in the decomposition of the pumice should be applied. Rolling will consolidate the soil and decrease the exceptional porosity. Other available deposits, such as eruption mud, crushed rhyolitic tuff, &c., containing more iron and fine particles than pumice, will assist in the general amelioration. Topographical surveys, followed by soil surveys, will enable lands of varying quality to be classified and mapped.

CONCLUSIONS.

Bush sickness is a progressive anæmia affecting ruminants only, leading to the death of the animals if they are not removed to healthy country.

Chemical analyses of the soils, pasture plants, and animal specimens from affected country show a deficiency of iron compared with what may be found in normal specimens from healthy country.

It was only logical to assume that the deficiency of iron in the animal is due to a deficiency of iron in the pasture brought about by the low amount present in available condition in the soil. To make certain, however, that this is the case, it was first necessary to eliminate all other possible causes of anæmia, since this condition might be brought about by chronic poisoning. Lengthy investigation has not revealed the presence of any poisonous element or compound. It was also necessary to test the hypothesis by all sorts of feeding-experiments, with various medicinal treatments as a preventive and as a cure. As it takes from six to twelve months for cattle to show signs of bush sickness, this testing has been a matter of years rather than of months. The original hypothesis, therefore, is now offered as a workable theory which its author has no doubt is absolutely sound.

There exist at least three other areas outside New Zealand where a similar disease exists, none of which has been traced to its cause. One of these, in North Britain, has been known for the past one hundred years. The New Zealand disease is the first occasion, so far as one can learn, of progressive anæmia in ruminants being credited to lack of iron in the green pasture. The importance of the matter to New Zealand is shown by the fact that there is probably an aggregate of over a million acres affected, which, could an economic cure be discovered, would be highly suitable for close settlement as dairy farms. The first step naturally being to discover the cause, the writer claims that this has now been demonstrated. It remains but to determine an effective and economic remedy, and experiments are being pushed forward in this direction.

NOTE.—The writer has much pleasure in acknowledging the willing and efficient help which has been rendered at all times in field and laboratory by his assistants, Messrs. F. T. Leighton, L. D. Foster, and R. E. Grimmett, M.Sc.

Wool-packs and Vegetable Fibres.—At its meeting held last month the Board of Agriculture considered a letter from the Bradford Chamber of Commerce pointing out the loss sustained owing to fibres of jute from the wool-packs becoming mixed with the wool. Such fibres could not be detected until the yarns were dyed, and the cost of picking them out of the cloth was a very considerable expense. It was suggested by the Chamber that paper linings should be used, to be partially paid for by the buyer of the wool. The Board came to the conclusion that if the inside of the pack was singed, as was the case with the outside, it might be a remedy, and a trial could be made by reversing the sides of the wool-pack. The Director-General of Agriculture agreed to procure from the Maitua Paper-mills a paper lining to experiment with, and for the purpose of ascertaining whether the suggestion was feasible in practice and cost. It was also reported that experiments were being made to manufacture a pack woven from wool, so as to entirely obviate the danger from jute-fibre, but this proposal had not yet reached the practical stage.

THE GRASSLANDS OF NEW ZEALAND.

REGRASSING EXPERIMENTS ON DETERIORATED HILL COUNTRY IN WHANGAMOMONA COUNTY.

E. BRUCE LEVY, Agrostologist, Biological Laboratory, Wellington.

IN the *Journal* for September, 1923, the writer described the main features of the Taranaki back country and the local problem of grassland deterioration. The district in question is broadly typical of the hilly bush lands of the North Island, particularly of the great mass of broken back country stretching from Wanganui to Raglan. Much of the formerly forest-clad areas of this region has reverted to fern and scrub growth, and the process is tending to increase rather than diminish. In the aggregate, hundreds of thousands of acres felled and grassed at a cost of several pounds per acre now carry practically no grass at all. The chief factor in this result has been lack of knowledge—a lack which can be made good only by systematic research, combined with analysis and pooling of the best practical experience of those settlers who have achieved success in grassing their holdings and maintaining the pasture.

This year a definite beginning has been made by the Department of Agriculture with regrassing experiments in Whangamomona County along the lines indicated, and the purpose of the present article is to record the scheme, together with its underlying principles. The experiments are co-operative, in that the farmer supplies the land and does most of the work, while the Department supplies all the seed necessary, supervises the sowing, and records results. The experimental areas were selected largely by the farmers themselves. In each district a small committee was set up, in most cases this being a sub-committee of the Settlers' Association of the district. The writer is intimately connected with the experiments, and is working in conjunction with Messrs. J. W. Deem and A. J. Glasson, district officers of the Fields Division, under the general guidance of the Director of the Division. Mr. A. H. Cockayne.

In these experiments the establishment of a close and continuous sward of grasses and clovers is the first consideration, for it is felt that without a close cover it is not possible to prevent weed-invasion, nor is it possible without the grass sward to successfully maintain stock on the area, and it is the stock—particularly cattle—which acts as the great clearing implement for the secondary growth of the hill country. By forcing cattle on to fern and other secondary growth it may be broken down, but unless the ground bared of the secondary growth becomes occupied by a grass sward it will become immediately open to invasion by herb-like weeds such as catsear, selfheal, cudweed, rib-grass, plantain, pipiriri, &c., or by hard fern. Again, even though much may be done by top-dressing with artificial manures, feeding out hay, and so forth, it is felt that if the manure (artificial fertilizer or stock manure) is applied to open grassland or on weeds a large proportion of the manure is wasted; whereas if there is a close and continuous grass and clover sward upon which the manure is used every available ounce of the latter is used by the



FIG. 1 BRACKEN-FERN SLOPE ON PROPERTY OF MR. FRED. COXHEAD, TAHORA, BEFORE BURNING AND SOWING.

The plots extend from the road-fence to the brow of the hill.

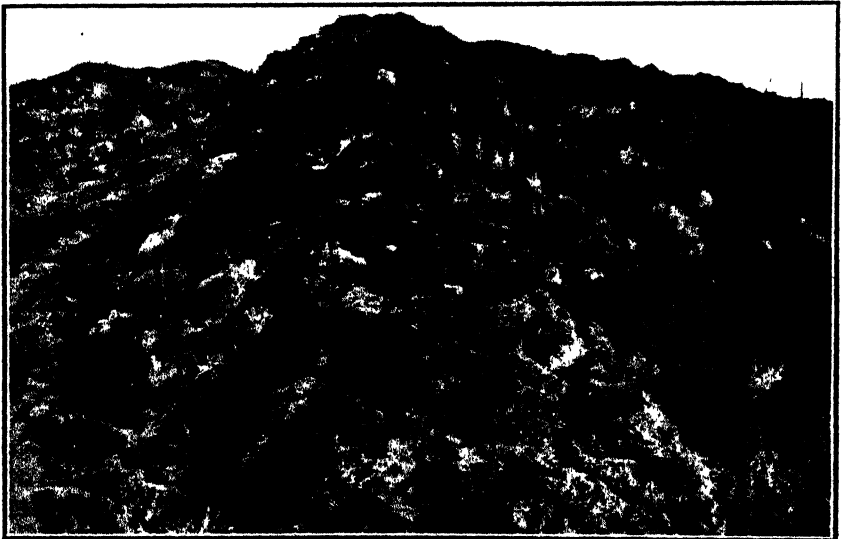


FIG. 2. KNOLL COVERED WITH TALL MANUKA AND BRACKEN-FERN, WITH WINE-BERRY-FUCHSIA GULLIES, ON PROPERTY OF MR. CLAUDE CARTER, TAHORA.

The slope (shady side on left) was winter-felled, and the greatest difficulty was found in getting a burn. The slope on the right, mainly manuka, was not felled until a few weeks before burning; on this side a clean hot burn was secured. The plots take in the whole of this knoll.

[Photos by E. Bruce Levy.

plants which it is desired to stimulate; further, there is not nearly the same loss through actual washing off the surface.

Nearly all the common grasses and clovers known to New Zealand agriculture at the present time are being in one way or another tested in the experiments. Due consideration has been given to those important principles enunciated in the writer's article published in the May issue of the *Journal* (pages 294-300), a synopsis of which is worth repeating here. The common grasses and clovers may be divided up into groups. Each group has a standard of soil-fertility that must be maintained in order that the species of that group may thrive. The first-class "better" grasses and clovers demand the highest state of soil-fertility. These grasses persist and thrive just so long as they are fed up to their full capacity. When the fertility of the soil falls below the standard of the first-class grasses and clovers the yield of these species falls off, and the plants dwindle and become small and stunted. This means an opening-up of the turf, and then, if there are none of the lower-fertility-demanding grasses sown to take up the running, the area will undoubtedly run to weeds. Poorer grasses or weeds spreading in a pasture indicate clearly that the fertility has fallen below the standard of the better grasses. When the fertility falls the better grasses do not die out entirely, but remain small and stunted—mere vestiges persisting among the stronger and ranker growth of the lower-fertility-demanding grasses. While there is life in these vestiges of the better grasses there is hope for the improvement of that sward. Immediately the fertility of such a soil is raised to the standard of the better grasses these soon spring into vigorous growth and begin to oust the poorer grasses. To act as pioneers in the processes necessary to effect consolidation of the soil surface, or to deal with strong secondary growth and to take up the running should the soil-fertility fall, the poorer grasses and clovers are essential.

In the experiments laid down most mixtures contain grasses and clovers that in the aggregate will thrive over a wide range of soils and conditions, so that if it is not possible to keep the fertility up to the standard of the better grasses and clovers there will be some species that will thrive and form some sort of a grass sward until such time as it is possible to raise the fertility of that soil. The pioneering elements have not been lost sight of. Some quickly establishing species have been put into the mixtures, not with the hope of retaining these species as permanent elements of the pasture, but to afford some rapid feed so that plenty of stock may be kept on the area in the spring-time, when fern and other secondary growth is making headway. There are included also those plants that will penetrate into the secondary growth and will persist there, producing feed that will induce stock on to these parts during the late autumn and winter. In one series shown in Table 1 (mixtures Nos. 1-4) the basis of the mixture is the same throughout, but the amounts of the finer, turf-forming grasses* vary. The endeavour is to get plots side by side containing respectively a large proportion of danthonia, brown-top, paspalum, and Chewings fescue. It is felt that one or more of these four low-fertility-demanding grasses must be added to all mixtures

* For a definition of the term "finer" grasses as used in these articles see note at foot of page 290 in *Journal* for May last.

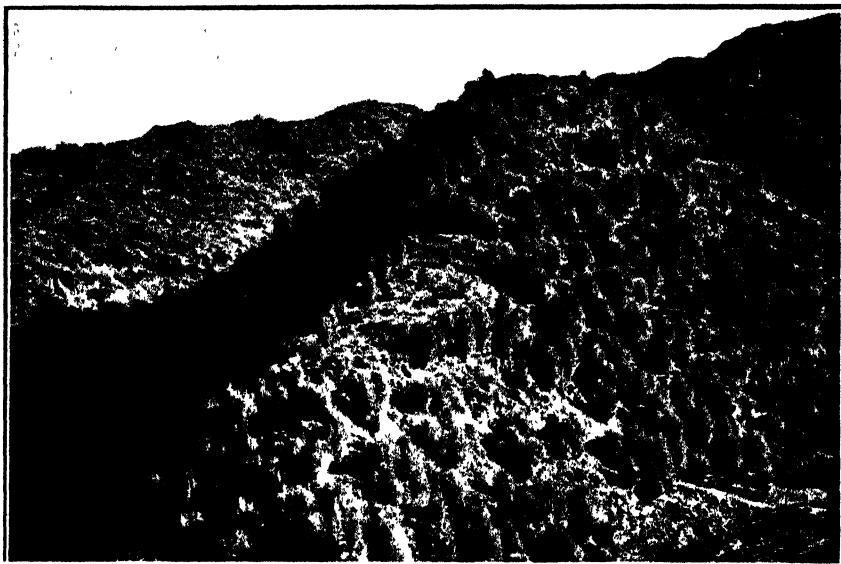


FIG. 3. KNOLL CARRYING SPARSE MANUKA AND SOMEWHAT STUNTED BRACKEN-FERN ON PROPERTY OF MR OSTLER, KOHURATAHI.

Photographed previous to the manuka being cut. On the left is a dark mossy slope. The plots extend over the hill-crest from gully to gully.



FIG. 4. SLOPE CONSISTING OF HARD FERN AND WEAK TURF ON PROPERTY OF MR. RAUGHAN, KOHURATAHI.

The plots extend out $4\frac{1}{2}$ chains from the fence on the right, and occupy nearly the whole of the area shown in photo.

[Photos by E. Bruce Levy.

of secondary-scrub burns, but just which one or ones are the best to use can be ascertained only by definite experiment. Finer grasses dominant in the mixture come in for a good trial (mixture No. 5). The disadvantage of including finer grasses only, however, lies in the fact that there is not the same chance of improvement, as far as quality of the pasture is concerned, if at a later date the fertility of that soil can be raised. The seed of the finer grasses also is expensive. It will be interesting, however, to see what a heavy sowing of these grasses results in. In mixture No. 6 no rye-grass is included, and the finer grasses are reduced to about what one would consider a normal sowing of these. Mixture No. 7 is high in clovers, with a normal seeding of finer grasses. In mixture No. 8 twenty-nine different kinds of plants are used—practically all the common ones used in grasslands anywhere in New Zealand. It will be extremely interesting to see which kinds out of all these will ultimately predominate as time goes on. In mixture No. 9 *paspalum*, *Chewings fescue*, and *Poa pratensis* have been eliminated altogether, and reliance placed on brown-top and *danthonia* as far as the finer grasses are concerned. In the Whangamomona district a certain amount of *paspalum* is already established, and there is no doubt that, could a better winter-fed provision be secured from these pastures, this grass would increase greatly in favour. By sowing mixture No. 10 on top of the already existing *paspalum* pasture it is hoped to introduce certain companion winter-growing plants. Subterranean clover is of outstanding promise in this respect, and *Lotus hispidus* and crested dogtail are certainly highly desirable to have associated with the *paspalum*. Mixtures No. 11 and No. 12 are sown on primary-forest burn, mixture No. 11 being used on the lower and better country and No. 12 on the upper ridge country. These two mixtures are heavy, and are not intended as type mixtures for this class of country. On the rest of the burn adjacent to these plots the occupiers, Messrs. Murphy Bros., have sown a good general mixture, and in our tests certain additional species have been included—namely, *paspalum*, meadow-foxtail, *Poa trivialis*, and meadow-fescue. The trial is really a test of these additional species, which latter, being put in over and above the good general mixture, make the seeding appear very heavy. In most cases the mixtures as set out in Table 1 are too expensive, particularly so where an excess of certain of the finer turf-forming grasses has been included. Probably none of the mixtures as here set out will be the final ones adopted, but the cheapest and most efficacious mixtures will be drawn up for the different types of country from results secured by an analysis of the turfs produced by each seeding.

In setting out these experiments as many types of secondary growth and as many different aspects of slope, &c., as possible were selected for inclusion. The type of the stock carried and the method of farming practised also vary on the different farms where the experiments are being conducted. An examination of results of the same mixtures under different types of stocking and farm-management will therefore be made, and this will be of great interest.

The experiments include the following: (1) Felling, burning, and sowing of dense manuka; (2) felling, burning, and sowing of scattered manuka, fern, &c.; (3) burning and sowing of bracken-fern; (4) burning

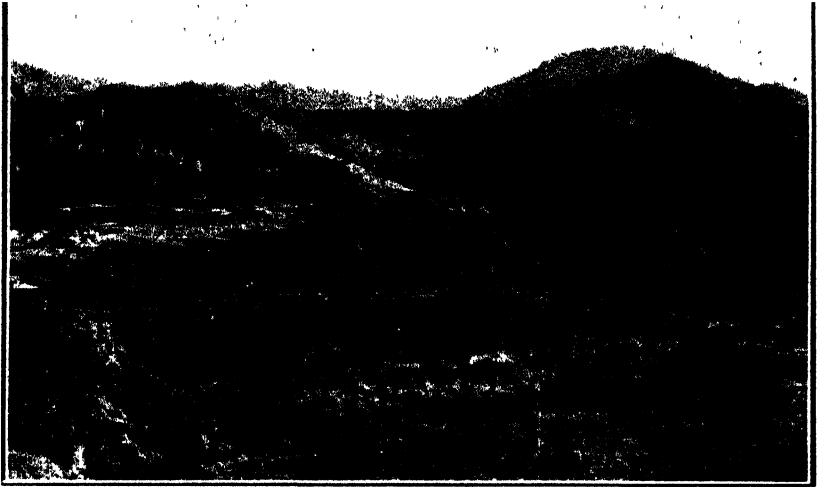


FIG. 5. HARD-FERN AND MANUKA AREA ON PROPERTY OF MR BOTTOMLEY, WHANGAMOMONA.

Portion of the hard-fern face on left was grubbed before sowing. The plots take in all the middle distance beyond railway-line.

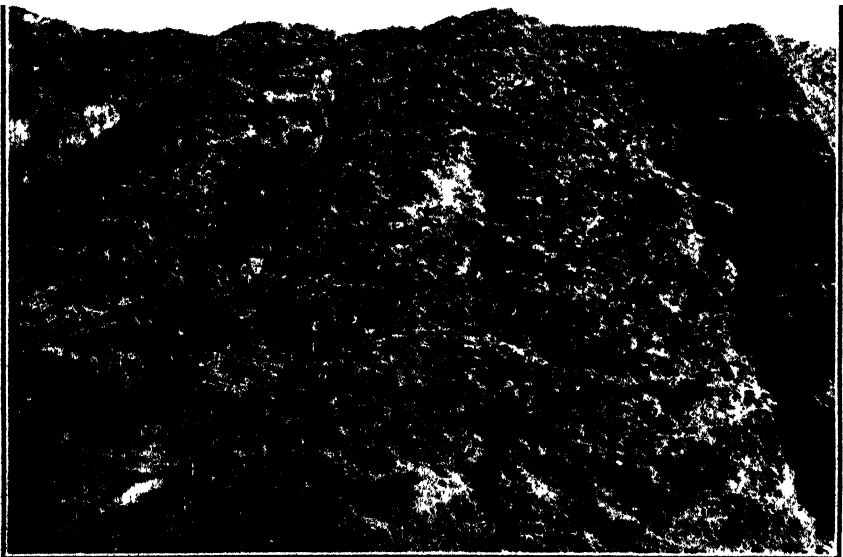


FIG. 6. BRACKEN-FERN SLOPE ON PROPERTY OF MR. J. MCCLUGGAGE, WHANGAMOMONA; WINEBERRY, WHEKI, TUTU, ETC., IN GULLIES.

The plots occupy nearly the whole area shown, and run from the gully below to the hill-crest, being parallel to fence on right.

[Photos by E. Bruce Levy.

and sowing of hard fern and patches of water-fern; (5) surface-sowing of weak pasture turfs to see if such may be improved by introduction of additional species; (6) surface-sowing of pipiriri-infested areas; (7) felling, burning, and sowing of wineberry, fuchsia, &c.; (8) felling, burning, and sowing of primary forest.

In each place and for most classes of growth blocks of from 4 to 7 acres in area were sown. Each of these areas is divided up into 1-acre plots, and on each 1-acre plot on any one area a different grass-seed mixture is sown. From this it will be seen that the experiments are on a practical field scale; none is being especially fenced off, so that they will take their chance with the rest of the paddocks as far as stocking and management are concerned. The following table gives the different seed-mixtures included in the trials:—

Table 1.—*Experimental Grass-seed Mixtures sown, Whangamomona County.*

Mixture.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Cocksfoot ..	8	8	8	8	10	10	4	8	8	8	8	8
Crested dogstail ..	4	4	4	4	6	6	2	6	6	4	6	6
Perennial rye-grass ..	6	6	6	6	4	4	4	4	4	6	6	6
Italian rye-grass ..	2	2	2	2	6	6	2	2	2	2	2	2
Poa pratensis ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	1	1	1	1	1	1	1
Brown-top ..	$\frac{1}{2}$	2	$\frac{1}{2}$	$\frac{1}{2}$	4	1	1	$\frac{1}{2}$	2	1	2	2
Danthonia pilosa ..	8	1	1	1	8	4	3	1	4	5	6	6
Paspalum ..	2	2	2	8	2	2	2	1	2	4	4	4
Chewings fescue ..	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2}$	1	1	1	$\frac{1}{2}$	1	1	1	1
White clover ..	1	1	1	1	$\frac{1}{2}$	$\frac{1}{2}$	2	$\frac{1}{2}$	1	1	$\frac{1}{2}$	$\frac{1}{2}$
Lotus major ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$
Lotus hispidus ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$
Red clover ..	1	1	1	1	1	1	2	$\frac{1}{2}$	$\frac{1}{2}$	1	2	1
Subterranean clover ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$	1	$\frac{1}{2}$	$\frac{1}{2}$
Yarrow ..	$\frac{3}{2}$	$\frac{1}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	1	1	1
Meadow-foxtail ..	2	2	2	2	2	2	2	2	2	4	4	4
Poa trivialis ..	1	1	1	1	1	1	1	$\frac{1}{2}$	$\frac{1}{2}$	1	1	1
Timothy ..	2	2	2	2	2	2	2	2	2	2	2	2
Tall fescue ..	1	1	1	1	1	1	1	1	1	1	1	1
Tall oat-grass ..	2	2	2	2	2	2	2	2	2	2	2	2
Meadow-fescue ..	2	2	2	2	2	2	2	2	2	2	2	2
English trefoil ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Lotus corniculatus ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Strawberry clover ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Crimson clover ..	1	1	1	1	1	1	1	1	1	1	1	1
Alsike ..	1	1	1	1	1	1	1	1	1	1	1	1
Red-top ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Rape ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Turnip ..	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
Total per acre ..	34 $\frac{3}{4}$	20 $\frac{1}{2}$	37 $\frac{1}{2}$	33 $\frac{1}{2}$	34	25	23	31 $\frac{1}{2}$	29 $\frac{1}{2}$	11	46 $\frac{1}{2}$	41 $\frac{1}{2}$

($\frac{3}{4}$ lb. = $\frac{1}{2}$ oz.; $\frac{1}{2}$ lb. = 1 oz.; $\frac{1}{4}$ lb. = 2 oz.)

No. 1. General mixture—danthonia dominant. No. 2. General mixture—brown-top dominant. No. 3. General mixture—Chewings fescue dominant. No. 4. General mixture—paspalum dominant. No. 5. Finer grasses dominant, to succeed temporary rye-grass. No. 6. General mixture, including finer grasses without rye-grass. No. 7. Finer grasses, and heavy in clovers. No. 8. Mixture containing most common grasses and clovers. No. 9. General mixture with small number of species of finer grasses. No. 10. For sowing on established paspalum. No. 11. Primary-bush-burn mixture, testing additional species. No. 12. Primary-bush-burn mixture, with large quantity of finer grasses.

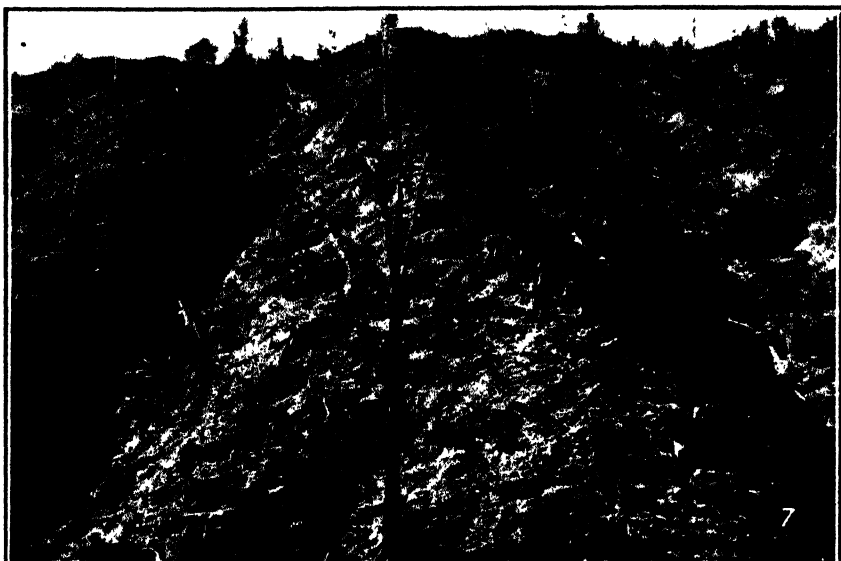


FIG. 7. HARD-FERN SLOPE ON SIDE OF GULLY OPPOSITE AREA SHOWN IN FIG. 6.

The plots occupy most of the area shown, and extend from the gully below up to the hill-crest.



FIG. 8. PRIMARY-FOREST BURN ON PROPERTY OF MURPHY BROS., AOTUHIA.

Mr. W. Murphy is shown sowing the experimental area.

[Photos by E. Bruce Levy.]

Table 2—Location and Description of Areas sown

Area on Property of	Type of Country.	Mixtures used. (See Table 1.)	Date sown.	Remarks.
F. Coxhead, Tahora (Fig. 1)	Patchy bracken-fern; sunny aspect	1, 2, 3, 4, 5	7/3/24	Fairly good burn, considering patchy nature of fern.
C. Carter, Tahora (Fig. 2)	Tall, dense manuka, and odd gulches with fuchsia, wineberry, and fern	1, 2, 3, 4, 5, 6	6/3/24	Hard, clean burn on dense manuka slope, but poor burn on shady wine- berry slope and gullies.
Wilson and Son, Putiki- tuna Rd., Kohuratahi	Hard fern mainly; patches of water-fern and open weak grass turf	1, 2, 3, 4, 5, 7, 8	24/3/24	Clean hard burn; burnt early in February; very little ash remaining when sown.
J. Ostler, Kohuratahi (Fig. 3)	Stunted bracken and scat- tered manuka; weak turf, mossy slope, and wineberry gully	1, 2, 4, 5, 7	22/3/24	Fair burn on bracken slope, but poor on shady slope and wineberry gully.
J. Ostler, Kohuratahi	Established paspalum	10	26/1/24	Attempt to introduce winter-feed-producing plants
J. Raughan, Kohuratahi (Fig. 4)	Hard fern mainly; weak, open turf; some water-fern and manuka	1, 2, 3, 4, 5, 6	14/3/24	Fairly good burn, but not hard on ground surface to scorch rhizome of fern
A. Bottomley, Whanga- momona (Fig. 5)	Hard fern and manuka; weak, open turf	1, 5, 7, 9	21/3/24	Fairly clean burn; small area of hard fern grubbed.
J. McCluggage, Whanga- momona (Fig. 6)	Bracken-fern; steep slope; sunny aspect, with shady gullies	1, 2, 4, 5, 8	5/3/24	Fairly good burn, but not hard; hard-fern patches not burnt to rhizome.
J. McCluggage, Whanga- momona (Fig. 7)	Patches of hard fern; weak turf; shady as- pect	1, 2, 3, 5, 6	7/3/24	Patches not burnt clean to edge, and burn too light to kill surface rhizome.
A. Coxhead, Whanga- momona	Manuka slopes; hard- fern patches and wine- berry gullies	1, 2, 4, 5, 7, 8, 9	22/3/24	Fairly good burn; greater portion burnt early in February; 1 acre burnt 4/3/24 and sown 5/3/24
Murphy Bros., Aotuhia (Fig. 8)	Primary - forest burn; ridges, kamahi domi- nant, lower slopes, tawa, rimu, and pu- katea mainly	11, 12	10/3/24	Burnt before Christmas; 2½ acres of each mixture sown; good clean burn
R. McCluggage, Pohokura	Fall bracken-fern and manuka; wheki and other scrub growth	1, 2, 4, 8	26/3/24	Fairly good burn, except- ing round edges of area.
A. McCluggage, Pohokura	Established paspalum and open cocksfoot turf	10	21/3/24	Attempt to improve winter feeding of paspalum pasture.
E. J. Wilde, Pohokura	Stunted, half-crushed-out bracken mainly; ma- nuka spur and hard- fern patches	1, 2, 3, 4, 5, 7, 8	20/3/24	Difficult to burn, except- ing manuka slope, which burnt hard and clean.
H. Barwick, Te Wera	Manuka and hard-fern patches; open turf and pipipi	1, 2, 4, 7, 9	19/3/24	Fairly good burn, except- ing some hard-fern patches.
A. J. Stonewigg, Te Wera	Manuka, hard fern, and bracken; tutu gullies	1, 2, 5, 6, 8	27/3/24	Mostly patch-burning on a difficult slope.
C. V. Kidd, Strathmore (Fig. 9)	Tall, heavy manuka and bracken-fern in parts	1, 2, 3, 4, 5, 8	24/3/24	A splendid burn; on ma- nuka portion clean and hard.

NOTE.—Certain of the above dates are only approximate. On some areas the sowings extended over a period of from two to six days.

The experimental plots in the aggregate cover 84 acres of hill land, and the areas sown are representative of most soil-types and most forms of secondary growth that occur in the Taranaki back country. The trials will be of value not only to the immediate neighbourhood, for the results will be applicable to almost the whole of the broken bush country of the North Island, and any plots put down in other parts will be more or less demonstrational of results secured in the Whangamomona County.

Owing to the wet season experienced it was found impossible to burn at all well the wineberry-fuchsia gullies, nor any large area of

water-fern. Intense burns of hard fern so that the surface rhizomes were scorched and killed were difficult to get, and in most cases there is bound to be a fairly rapid return of the hard-fern growth. However, it is hoped that the shade-enduring and pioneering plants included in the mixtures will come on and thrive among the hard fern, providing a sufficiency of feed there to induce stock to graze and tread upon the patches. The bracken-fern burnt well on the whole, but throughout the time of burning the lack of wind rendered repeated torching of the clumps necessary. It would appear that too hard a burning of bracken-fern areas is not advisable, and that if an inch or so of dead fronds could be left unburnt on the ground this would ensure a much better



FIG. 9. SOWING MANUKA BURN ON MESSRS. KIDD AND POPE'S PROPERTY AT STRATHMORE.

This area was cut only a few weeks before burning. Portion only of the area is shown in photo.

[Photo by J. M. Smith.]

establishment of the seed ; there would not be the same danger of sun-burning of the young seedlings, nor such a loss from bird depredations. If too much dead frond is left, however, the seedlings will be exhausted before they can get their leaves to the light. In several instances we found in burning that a light fire took nearly everything on the drier portions, but left a big mass of dead fronds, often 1 ft. thick, in the damper hollows or on the shady slopes. These latter patches after two or three days of fine weather could readily be fired again, and then an excellent seed-bed was secured over the whole area.

In the burning of the manuka fierce hot fires were secured, particularly so on those slopes where the manuka had been cut only three or four weeks before firing. On two areas the last of the manuka was

not cut until about a week before the fire. These areas burnt splendidly even after not more than three days of fine weather. On the other hand, on those areas where the manuka had been cut in winter or early spring, burning was often difficult, especially so where the manuka was sparse. Growth of young fern and grass got among it, and then these areas required about ten days of fine weather before they were dry enough to carry a fire well. Where the manuka was dense, so that a complete cover of fallen manuka was formed on the ground, there was no fern or other growth coming through, and these areas burnt well after a few days of fine weather. It would certainly appear that sparse manuka should not be winter-cut, but should be left to within a few weeks of burning-time. The thicker, denser manuka slopes, however, may quite safely be cut in the winter, although these burn even more readily when felled only three or four weeks before firing. The winter-time, however, generally affords the greater opportunities for cutting manuka, but during that time felling should be confined to the denser areas. Wineberry, tutu, fuchsia, and lacebark gullies should not be cut in the winter where wet summers are experienced. Even where these growths were thrown into heaps after being felled the greatest difficulty was experienced in getting a burn. Water-fern and other young growth comes away through the felled scrub during the spring, and it is this growth which prevents firing. Again, all the leaves fall off, leaving only bare sticks, and, unless one gets a dry spell with good wind, burning is out of the question.

In Whangamomona County fairly good burns of secondary growth may frequently be secured early in the summer, and many settlers seize upon this opportunity to burn. In the case of hard fern and water-fern, and felled wineberry, fuchsia, &c., early summer burning after a good dry spell would seem advisable, but the grass-seed should not be sown immediately after the burn, because of the great danger of sun-burning of the young seedlings. Early summer burns of manuka and bracken-fern are not advisable, for felled manuka (and manuka should never be burnt standing) can well be burnt later when conditions are more suitable for the establishment of the grass-seed sown. It must be remembered that a freshly burnt area affords a better chance of seed-establishment than does an area that has been burnt for some time and the ash washed off or consolidated. Summer burning of bracken-fern before the end of February is not advisable, because of the speedy return of the bracken-fern after the fire. Bracken-fern should be burnt as late in the autumn as possible, so that there may be no return of the bracken growth until the following spring. This gives the young grass a very much better chance of becoming established, and there is no need for the "heart" to be eaten out of the young grass, which is very liable to happen if any reappearing young fern coming away after the burn in the autumn has to be dealt with.

In these trial sowings a great many different kinds of seed-beds have been secured, and this point of establishment of the seed sown will be dealt with in a later article when giving a progress report of the experiments.

New Rabbit District.—The Harapepe Rabbit District (Raglan County) has been constituted for the purpose of Part III of the Rabbit Nuisance Act.

PLANT-SELECTION AND SEED-PRODUCTION.

WORK AT THE MOA SEED FARM.

(Continued.)

J. W. HADFIELD, Manager, Moa Seed Farm, Dumbarton, Central Otago.

II. SEED-PRODUCTION.

IN the first part of this article, published in last month's *Journal*, the writer outlined methods adopted on the Moa Seed Farm in raising stock seed, and his present intention is to briefly discuss the methods adopted in the production of commercial seed.

The importance of plant-selection to the seed-grower has already been indicated, and it can be readily appreciated that the work requires a fair amount of skill and patience. On the other hand, the production of commercial seed is work which no farmer need hesitate to undertake, provided he is painstaking in his methods. Ethics, also, have an important bearing upon seed-growing, since in no other type of farming does the purchaser have to depend so completely upon the word of the grower. Germination and purity tests and inspection of the seed will not reveal whether the grower has taken the necessary precautions against cross-pollination with another variety, nor whether he conscientiously culled his roots when digging. The purity of the variety, and its type and quality, can only be determined after some of the seed is grown, and as probably all the seed will by then have been distributed it is generally too late to remedy any mistake. The farmer may therefore find great difficulty in producing stock seed, without which quality and type will deteriorate, or, as an alternative, he will be faced with the necessity of culling heavily each year if a reasonably high standard is to be maintained. This difficulty is overcome by the seedsman raising the stock seed and distributing it to his growers, who produce on contract.

The great obstacle to extensive seed-growing in this country, and one which probably overshadows all others, is the cost of production, the main item, of course, being labour. On the other hand, it may be considered that certain parts of the Dominion are very well suited for seed-production, and with reliable information and labour-saving methods and appliances the future prospects are decidedly bright. The cost of production on this Moa Farm has been relatively high, to which further reference will be made; but our seed has always been of very fine appearance and high germination, and our yields considerably higher than those reported as being the average of the Californian seed crops.

It is not intended to here deal with clover, lucerne, grasses, peas, and cereals, all of which are grown commercially for seed purposes both on the Moa Farm and also throughout New Zealand; attention will be confined to vegetable and root seeds which are grown on this Farm, but are not commonly grown by farmers.

There is practically no literature available dealing with seed-production, and it is difficult to get reliable information regarding methods adopted in the large seed-producing areas of Europe, Asia, and America.

The explanation lies—in part, at least—in the fact of the relatively few growers compared with the number of consumers. This is better appreciated when it is pointed out that one man, were he to get the assistance of a few boys at harvest-time, would have no difficulty in producing sufficient seed to sow 2,000 acres of parsnips. Carrot, lettuce, radish, onion, cabbage, turnip, celery, and flower seeds are more or less parallel cases. The growing of these seeds is in the hands of a few, and a large number of these growers assess the knowledge they have as part of their stock-in-trade, and, rightly or wrongly, refuse to part with it. The methods advocated here are almost entirely the outcome of our own experience during the last four years, though methods adopted in other countries will sometimes be referred to.

CULLING.

Each individual plant possesses certain characteristics which are the result of two influences brought to bear upon it. The first is the effect of environment, and the second is heredity. Particularly in roots the shape and quality are largely influenced by soil and season, the manure applied, and the care and cultivation given to the crop. These influences are temporary, and have to be repeated to produce the same effect upon a succeeding crop. They form, in fact, part of the environment of the plant, resulting in certain characteristics which are not transmitted by inheritance. On the other hand, each plant is of a definitely constituted type, possessing merits and demerits predetermined by inheritance, and these characteristics may be transmitted. An equal increase in yield may be brought about either by manuring or by breeding. The one costs little, but is a very temporary and sometimes erratic increase, whereas the initial cost of raising a high-yielding strain may be greater, but it is of infinitely greater value.

When, therefore, a malformed root is dug up it is really not known whether the defect is due to inheritance or to environment, though a very good guess can often be made. Nevertheless, the root has to be discarded, for though the defect may after all be due to its environment, and it may produce quite satisfactory descendants, yet there is the possibility of the defect having been inherited, and the probability of it being transmitted. For this reason, if for no other, roots should be given the most favourable conditions for development, and this applies particularly to roots grown for the production of stock seed. Favourable conditions will largely mitigate the environmental influences overshadowing those of heredity. Great discrimination should be observed in culling, and a root should, to a large extent, be judged by comparison with those around. Thus, a small mangold, if it comes from poor soil, and is reasonably large in comparison with those around, should be retained in preference to one perhaps much larger but growing in a richer piece of land and relatively poorer in comparison with its neighbours.

In cross-pollinated plants, such as most biennial roots, considerable improvement is effected by continued selection within a strain raised from a single-plant selection; but with self-fertilized plants, as, for example, garden peas, once a pure line has been isolated it is not likely that continued selection will result in further improvement.

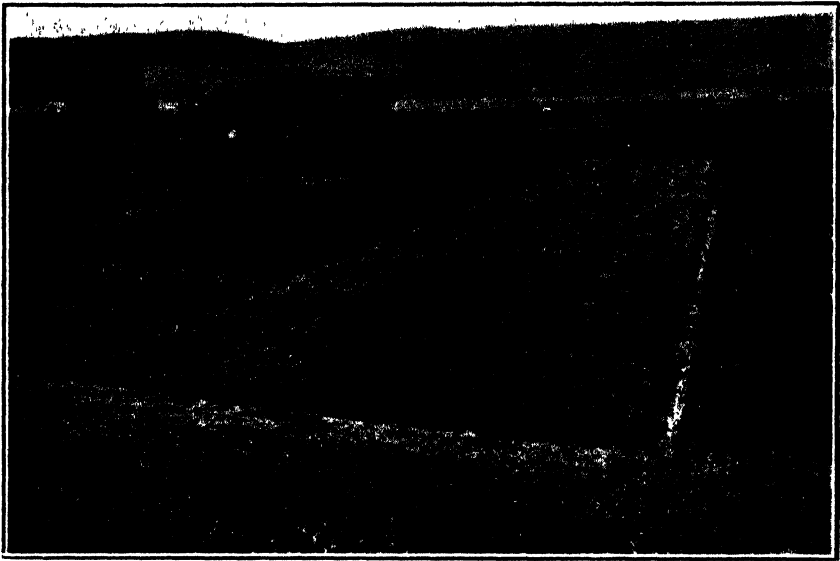


FIG. 1. VIEW OF HOMESTEAD SECTION AT MOA SEED FARM, WITH TEVIOT STATION IN THE DISTANCE.

In foreground—from left to right—are one-acre plots of lettuce (commencing to shoot), French breakfast radish (in full flower), and scarlet runner beans. On the left of these are the trial plots.



FIG. 2. ONION-SEED CROP IN FULL FLOWER.

SOWING AND CULTIVATION.

The sowing of root crops at the Moa Farm commences with onion-seed about August, and ends with beet-root about October. With the exception of the onion crop there is not much to be gained by early sowing, as most varieties have ample time to sufficiently develop before being dug in the winter, and late sowing enables one or two crops of weeds to be eradicated. Land for carrots and parsnips should be light and friable. Heavy land that is poorly drained causes a large number of malformed roots in carrots, while, on the other hand, we find that the heavier soil produces better beet-root and globe mangolds, both in roots and seed.

To facilitate thinning we sow on a ridge made with a disk ridger, in rows 27 in. apart. On friable and silty land the ridger does excellent work, but on heavy land the tendency is for the hard lumps on the surface to be thrown to the centre of the ridge, and the seed when sown drops in among these and germinates irregularly. We overcome this difficulty to some extent by dragging a light clod-crusher behind the ridger. This serves the double purpose of pulverizing the soil and levelling off the top of the ridge. A high ridge is not desirable in any variety of carrot which produces its root entirely in the ground. If too high, thinning exposes too large a portion of the young root, resulting in contracted necks and otherwise malformed roots. Seed is sown on the top of the ridge with a small hand seed-drill.

We use no fertilizers on the farm except for potatoes and peas, and it is only in moist seasons that even these crops show much benefit from this treatment. We have carried out many trials, leaving strips unmanured or manuring strips of cereals, also top-dressing lucerne and clovers, but have never noticed any difference.*

Thinning we perform as much as possible by hand, and as little as possible with the hoe. The objective is the production of the largest possible number of medium-sized and perfectly shaped roots. Mangold and beet are thinned almost exclusively with the hoe, but undoubtedly the most satisfactory and perhaps even the most economical seed roots are obtained by hand thinning.

HARVESTING ROOTS.

With the completion of threshing and seed-cleaning operations in March, the onion crop receives first attention. This is followed by potato-digging, which we generally complete before the end of May. As severe frosts may now be experienced the beet-root crop has next attention, followed by mangold, carrot, and parsnip, in the order indicated. In each case shallow-rooted varieties receive preference, as these are far more liable to frost injury than those having long roots reaching down below the frozen ground.

During the winter of 1923 continued wet weather prevented the harvesting of roots until well into June. Following this we experienced several weeks of cold weather, registering as much as 20 degrees Fahrenheit of frost. The ground was frozen for some weeks, and the shallow roots were lifted out of the soil. Freezing ruptures the cell structure of the root, and also results in a considerable loss of moisture. This may explain why roots extending well down into the ground seemed able

* Readers interested in this aspect may be referred to an article on the mica-schist soils of Central Otago, &c., by B. C. Aston, published in the *Journal* for June, 1923.

to draw upon a supply of moisture, and more readily overcome the effects of freezing. Whatever the explanation may be, the following list of approximate losses which we experienced during the 1923 winter is interesting in this connection, indicating that the shallow-rooted crops suffered most: Turnip-rooted beet, total loss; Crimson Globe beet, 80 per cent. loss; Yellow Globe mangold, 80 per cent.; Long Red mangold, 40 per cent.; Early Horn carrot, 40 per cent.; Intermediate carrot, 10 per cent.; Matchless White carrot, no loss. Parsnips appeared quite sound when ploughed out and planted in the spring. Probably 50 per cent. of the roots, however, developed a rot round the crown, for which we can find no explanation beyond frost injury. Fortunately, it did not materially affect the yield beyond a possible 2 per cent. During the same winter potatoes stored in the sheds were damaged, and a few which had frozen solid collapsed on thawing. The majority, however, showed only the usual frost injury, indicated by discoloration of the vascular tissue, which is brought about by exposure to a temperature of 26° to 27° F. for several hours.

We have never been fortunate enough to be able to harvest our parsnip roots before or during the winter. These have been left till the spring, and are ploughed out early in August, sorted, and immediately transplanted. There is some risk in doing this, as wet weather in August may cause delay, in which case the roots immediately commence to grow. Carrots, mangolds, and beets are dug by hand, but parsnips are ploughed out, and the fact that they are severed 8 in. to 9 in. below the crown apparently does not affect the yield of seed sufficiently to warrant hand digging.

The proportion of selected roots reserved for seed purposes rarely exceeds 33 per cent. of the total yield of carrots, 50 per cent. of parsnips and beet-root, and up to 75 per cent. of mangolds. These are topped, and pitted by stacking them upon the bare ground, covering with soil and a thick thatch of straw. In the spring they are carted direct from the pits and transplanted.

(To be continued.)

A NEW JERSEY CHAMPION—"VIVANDIERE."

ON 5th August the Jersey cow Vivandiere, bred and owned by A. Christie, of Tanekaha, North Auckland, completed her 365 days on certificate-of-record test. She commenced test at the age of six years and ten days, and her final record stands at 17,282.1 lb. of milk containing 1,036.09 lb. of butterfat. This constitutes a New Zealand record for the Jersey breed, the performance of the previous champion, Pretty's Flirt, having been exceeded by 598 lb. milk and 25.6 lb. butterfat. Vivandiere's record is all the more remarkable in that it was made on twice-a-day milking. It is expected that she will fully qualify for her certificate by calving well within the period prescribed by the rules. She is due to calve on 14th September, which will be less than six weeks after the termination of her 365 days of authenticated milking. Mr. Christie is to be congratulated upon the breeding, developing, and handling of the new champion, and also upon what is probably the world's record butterfat production for twice-a-day milking.

—W. M. Singleton, *Director of the Dairy Division.*

IRRIGATION AND ITS PRACTICE.

III. METHODS OF APPLYING WATER AND PREPARATION OF THE LAND.

(Continued.)

R. B. TENNENT, N.D.D., Instructor in Agriculture, Dunedin, and J. R. MARKS, A.M.Inst.C.E., M.N.Z.Soc.C.E., Resident Engineer, Public Works Department, Alexandra.

FURROW IRRIGATION.

IN the furrow method of irrigation small furrows or corrugations are made in the direction of the slope and connected with a head-ditch supplying water. As a general rule this method is used in the irrigation of orchards, small-fruits, root crops, maize, sorghum, and vegetables (Fig. 36). Usually a number of furrows are carrying water at once, and their length and size depend upon the soil, slope, and amount of water required. The length of the furrows should be such that for the given carrying-capacity both ends will be irrigated alike and to a proper depth. Speaking generally, the furrows will vary in length between 200 ft. and 500 ft. Where the soil is extremely porous the furrows will be comparatively short, and where the soil is tighter the reverse will be the case.

In preparing land for the furrow irrigation of crops it is usually desirable that the field should first of all be irrigated by a flooding method, in order to moisten the soil sufficiently so that the seed when sown or planted will germinate and be given a good start. When the crop shows through the ground, furrows are ploughed in the proper positions, or are made by the use of a special furrower, which will be described later. The sowing of the crop must, of course, be arranged so that the drills run parallel with the fall of the land. The furrows are made in such a direction that a little stream of water will flow freely down them without washing away the soil. Water is taken from the head-ditch, which follows approximately the contour of the surface, into the distributing-furrows, which may be parallel with the ditch or diverge from it. If the land is nearly flat the furrows can be run directly away from the distributing-ditch, from the upper to the lower level of the paddock. If, however, as shown in Fig. 37, the slopes are steep the furrows should be ploughed diagonally to the slope, so as to reduce the velocity of flow in them.

Water is diverted into a number of these furrows and makes its way slowly towards the lower end. As soon as this point has been reached the stream is shut off and turned into another set of furrows, and so on until all have been watered. The fall given to the furrows determines to a certain extent the amount of water received by the soil. Where the fall is very gentle the water moves slowly, and a large portion sinks in while the furrow is being filled; if steep, the water quickly passes to the lower end, and the ground does not have time to absorb as much.

In turning the water from the head-ditch into the furrows the common practice in Central Otago is to make openings in the lower



FIG. 36. FURROW IRRIGATION OF YOUNG FRUIT-TREES AT GALLOWAY EXPERIMENTAL AREA.

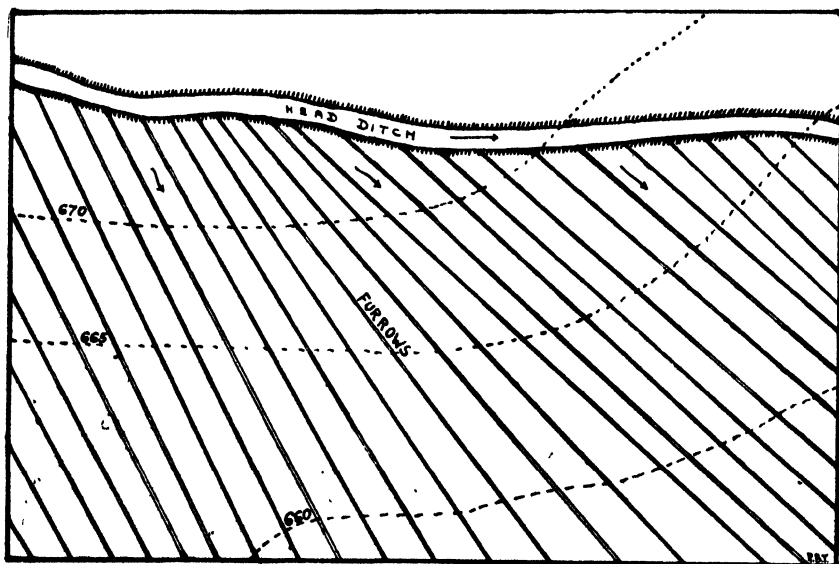


FIG. 37. SKETCH OF FURROW IRRIGATION ON STEEP SLOPE.

[Original.]

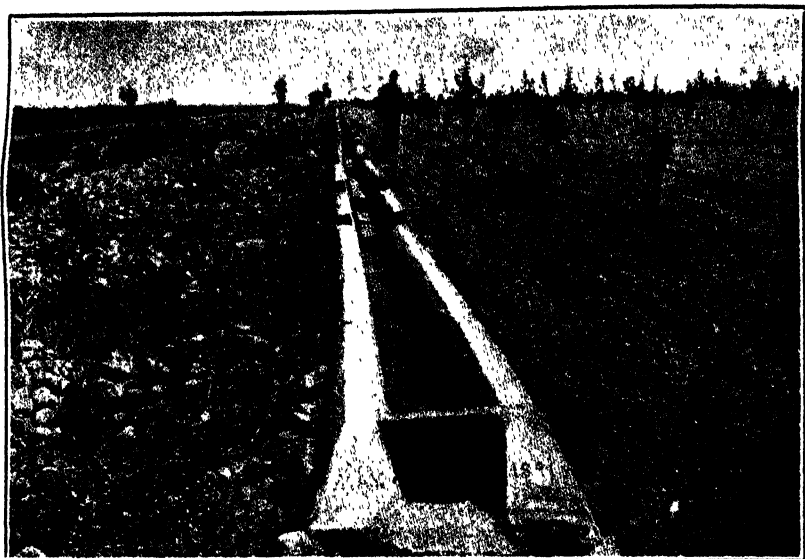


FIG. 38. CEMENT-LINED DISTRIBUTING-DITCH.

[Newell—"Irrigation."]

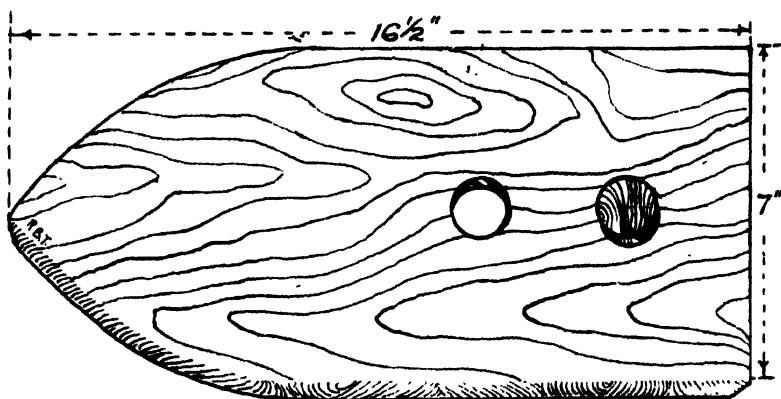


FIG. 39. WOODEN TAPOON AS USED AT GALLOWAY EXPERIMENTAL AREA.

[Original.]

bank with a shovel. If water is allowed to flow through earth openings in this manner for even a short period the distribution usually becomes unequal. The banks of the ditch readily absorb water and become soft. Erosion takes place and the openings are enlarged, permitting greater discharges and thus lowering the general level of the water in the ditch, so that some of the remaining furrows have little or no discharge. Where orchards or fields permanently laid out for furrow

irrigation are under consideration it would certainly be more economical to erect a permanent head-ditch into which are let lengths of 1 in. pipe blocked by a wooden plug. The erection of concrete or wooden head-ditches with sliding openings is usually adopted in America and in other countries. The permanency and absolute control of the water are features which recommend this type of structure (Fig. 38). Wooden tapoons can also be easily prepared, and are exceptionally useful in making outlets from earthen head-ditches. Fig. 39 shows the type used at the Galloway Experimental Area. This tapoon consists merely of a board of sufficient width to extend across the furrow. Where it is desired to let a certain amount of water pass this point one or more holes are bored in the tapoon, these being closed by a wooden plug when not in use.

From the foregoing it will be realized that for orchards the furrow method is the one likely to be used most generally. Occasionally one comes across orchards irrigated by six to ten shallow furrows between each row of trees (Fig. 40). It is generally recognized that two deep furrows 8 in. or 9 in. in depth, and running as close to the tree-limbs as can conveniently be done, are preferable when lateral percolation is not too slow. Where two such furrows are not sufficient four usually will be. The chief advantage of the furrow method of irrigating orchards, over the basin-check method previously described, lies in the smaller evaporation from the furrows and the elimination of caking of the surface soil.

PIPE IRRIGATION.

Only brief mention need be made of the variations in the system of utilizing pipes for irrigation purposes. Speaking generally, the use of pipes means a considerable outlay of money, and consequently the practice is not recommended unless under special circumstances. In certain cases pipe-lines take the place of head-ditches in the irrigation of orchards by the furrow method, and where sufficient outlets are allowed the system is excellent. A certain amount of sub-irrigation is also employed in various countries, porous hydrants being connected with an extensive piping-system. Fig. 41 shows an overhead spray system in use. This method, which was almost completely confined to the watering of lawns, has during recent years been extended to the irrigation of agricultural fields. As can be realized, only the most remunerative and most productive types of crops would warrant the expenditure necessary to install such a system. The large profits derived from such crops, the cost of fertilizers, the uneven character of the soil, the growing of two or more crops on the same field in one season, and the advantage of being able to control the soil-moisture in cultivating and recropping might justify, under favourable conditions, the heavy expense. In some systems the pipes are permanently fixed on overhead standards. In others they are laid about 1 ft. beneath the surface, so that they cannot be disturbed by the plough. The movable-pipe system is frequently used in Australia, and has the advantage of being less costly in the initial outlay, but it entails more labour in operating.



FIG. 40. FURROW IRRIGATION OF ORCHARD.

[Newell—"Irrigation,"]

FIG. 41. OVERHEAD SPRAY IRRIGATION, SHOWING PIPING.

[Fortier—"Uses of Water in Irrigation,"]

IV. IRRIGATION IMPLEMENTS.

Certain special implements are essential to the irrigation farmer in order to facilitate the preparation of his land for irrigation and to reduce the cost of such preparation to a minimum. No mention will here be made of the common farm implements usually used on the majority of New Zealand farms, attention only being directed to those special implements with which the average irrigator is as yet unacquainted, but which, we venture to say, will in the course of the next few years be looked upon as an essential complement to every irrigation farmer's equipment.

LEVEE RIDGER.

Attention has already been drawn to the fact that the levees in the border-dyke method of irrigation can be formed roughly by employing an implement known as the levee ridger. Fig. 32 (in the *June Journal*) shows the ridger in operation, while Fig. 42 gives a fair idea of how it may be made. The construction of this simple implement can readily be carried out on the farm, and it certainly should be in the hands of every farmer utilizing any system of irrigation in which low levees are employed. The levee ridger is drawn by two horses, with the wide end to the front. This wide end skims a thin layer of earth from the surface, heaping it together and letting it pass through the narrow rear end in the form of a slightly raised ridge. The dimensions of the ridger may be made to suit the requirements of the farmer. The ridger used at Galloway Experimental Area has been found to be quite satisfactory, the width of the front end being 6 ft., the length 9 ft., and the width at the narrow end 2 ft. 6 in. Weight is obtained by the driver standing on the central footboard.

SPECIAL PLOUGHS.

Generally speaking, the average irrigator will find the single-furrow swing plough of great advantage in forming furrows and preparing the way for ditches. Figs. 43 and 44, however, show two types of ploughs which merit consideration. Where furrow irrigation and any other controlled method of irrigation is employed, ploughing around the field should always be avoided, and all dead furrows should be eliminated as far as possible by back-furrowing into them several times. The lands in such cases should therefore be of considerable width, even if time is lost at the headlands. The ploughs illustrated are of a type greatly in vogue in the United States, in that they do away entirely with both back and dead furrows, since all furrows are thrown in the one direction. The plough is a sulky, and is made in two types, called "reversible" and "balance."

The reversible type consists of right-hand and left-hand mouldboards and shares set opposite each other on a beam. When the end of the field is reached the plough is thrown out of the ground and reversed by means of handles at the back, and when the implement is turned round the other plough throws the furrow in the same direction as the previous furrow. Another type, accomplishing the same purpose, consists of a sulky frame carrying right-hand and left-hand mouldboards, with levers for raising and lowering them, so that either can be held out of the ground while the other is in use.

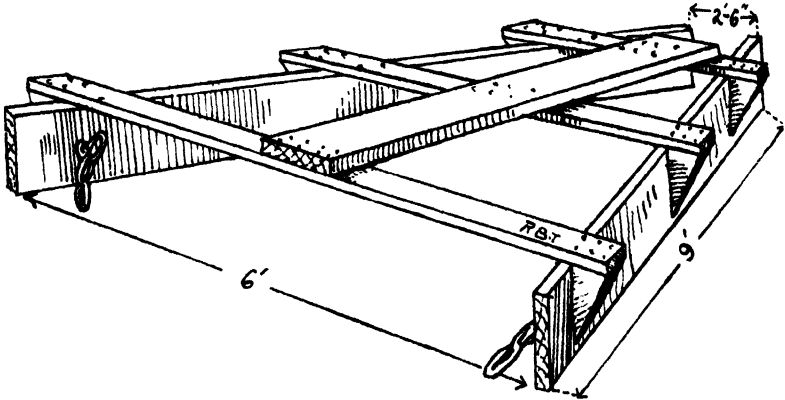


FIG. 42. LEVEE RIDGER.

[Original.]

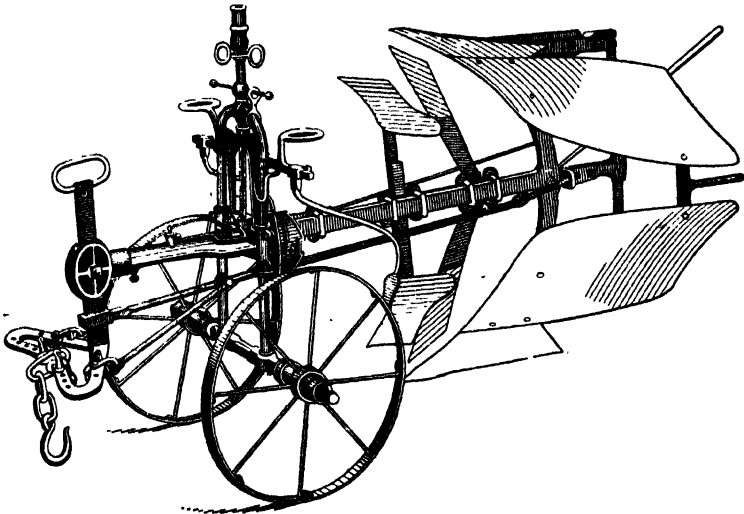


FIG. 43. REVERSIBLE PLOUGH.

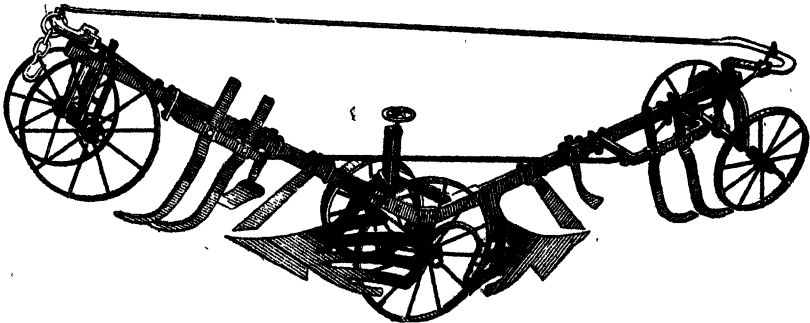


FIG. 44. BALANCE PLOUGH.

The balance plough consists of one or several ploughs in gangs, fastened to two frames which are set at an angle of 135° to one another, the axle and wheels being at an angle (Fig. 44). One frame contains right-hand and the other left-hand ploughs. The drawbars at the ends are joined by means of a heavy round steel rod, and a loose ring connects the team to the drawbar, so that when the end of the field is reached the team is swung round on the unploughed ground and the ring travels from one drawbar to the other by way of the rod; when the team is started up again one plough is pulled out of the ground and the other into it, thus obviating the necessity of throwing the plough out, as in the case of the reversible type.

EARTH-CROWDER.

One of the most frequent and heaviest operations in the preparation of land for irrigation is the formation of head-ditches. This operation can be largely simplified by the use of what is termed an "earth-crowder." Fig. 45 shows how this implement can be constructed by the farmer himself, and from the writers' own experience the crowder is well worth using. In forming head-ditches a few furrows are ploughed on the site of the ditch. The crowder then comes into operation, as can be seen in Fig. 46, and the earth is packed to the sides. Fresh furrows are then ploughed, and the crowder again brought into operation. Its use, as will be recognized, greatly facilitates the building of the banks of the head-ditch, and it is strongly recommended to irrigation farmers on this account.

FURROWING-SLEDGE.

Where furrow irrigation is to be carried out it is desirable to have a suitable implement with which to quickly form the furrows along which the water will flow. Taking for granted that a drill with furrowing attachment has been used in seeding, thus marking out the rows, or that the drills have been marked in some other convenient manner, the furrowing-sledge can then be brought into use.

The irrigator will, of course, construct a sledge according to his own requirements, and the home-made implement shown in Fig. 47 will serve as a pattern from which a furrowing-sledge may be constructed. It is made of 6 in. by 6 in. timber, 42 in. long for the runners, and wide enough to straddle two rows. These timbers are set to run on edge, and are sharpened at the front end, being armed with cultivating-tines which about fit them. The runners are securely spiked together at the back end, with 2 in. boards upon which the driver rides, and are connected in front by a 4 in. by 4 in. piece of timber, to which the draught is attached. Two horses are preferable in using this furrower, as the sledge can then be driven much straighter. The implement has the advantage over the ordinary furrowing attachment of cultivators in that it makes a smooth even furrow, without clods to interrupt the flow of water. With it furrows can be placed in alternate rows or in every row, as desired. Further runners could be placed on the sledge to furrow out more than two rows at a time, except that slight unevennesses in the surface will prevent the making of as good a job. Smooth furrows, especially for irrigating seed (a practice not generally recommended), are most essential, and no other implement can be secured to give as good results as this simple one.

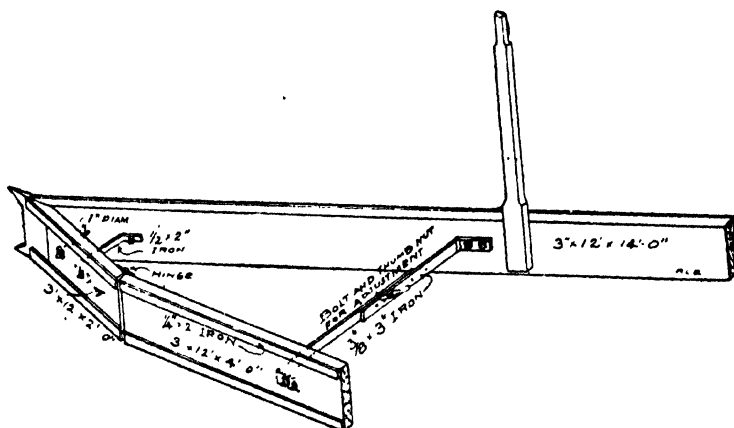


FIG. 45. ADJUSTABLE CROWDER.



FIG. 46. USE OF THE CROWDER IN BUILDING HEAD-DITCHES.

[Fortier—"Irrigation of Orchards."]

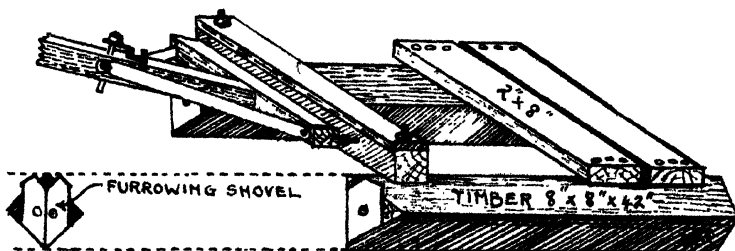


FIG. 47. FURROWING-SLEDGE.

[Original.]

SCOOPS.

Where a considerable amount of grading has to be carried out the use of a scoop or grader, if procurable, is to be recommended. The scoop is easy to handle, and is very suitable for forming roads, building levees, digging ditches, or carrying out any work requiring the removal of earth. The scoop illustrated in Fig. 48 is a most effective implement for the removal of loose or sandy earth where the haul is short. In practically every case, if efficient work is to be done, three good horses abreast are necessary. Its chief points of recommendation are strength, portability, and wide ranges of use, quick loading, and little loss of time in transportation. After the dumping of a load the team may be readily turned, and when empty the scoop is drawn with sagging traces. This type of scoop can be procured in New Zealand for approximately £7.

A modification of the ordinary scoop is termed the "buck scoop" (Fig. 49). This type of scraper is well suited to land where the grading

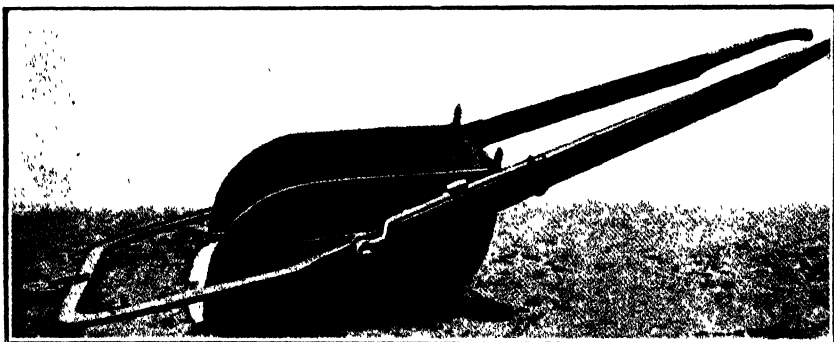


FIG. 48. LEVELLING-SCOOP.

[P. and D. Duncan, N.Z.]

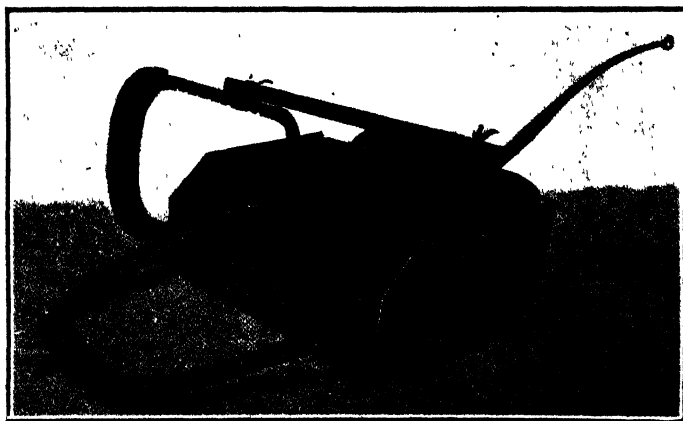


FIG. 49. BUCK SCOOP OR GRADER.

[P. and D. Duncan, N.Z.]

is heavy and the haul long. The single steel handle, about 4 ft. long, attached at the middle of the back of the scoop serves both as a means of regulating the dip in loading and of dumping and spreading the load. Usually a short piece of rope is attached to the end of the handle to facilitate turning the scoop back into position preparatory to loading. The scoop illustrated is 4 ft. 6 in. in width, and is drawn by four horses. Manufactured in New Zealand its price is £12.

THE FINISHING LEVELLER.

The leveller as an implement requires only a brief description, and Fig. 50 illustrates a type most suitable for Central Otago. As can be seen, the leveller consists of a rectangular framework well stayed with a central cross-piece bolted flush with the bottom of the side runners. This cross-piece catches any inequalities in the soil and

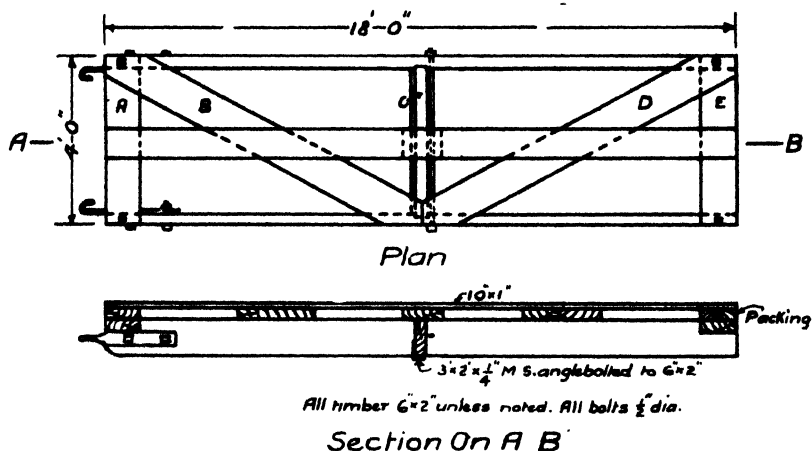


FIG. 50. FINISHING LEVELLER.

[Original.]

deposits the elevated portion into any depressions which may exist. The writers cannot overstress the great necessity for farmers to make use of an implement of this nature for putting the finishing touches on their land prior to irrigation. A well-graded and well-levelled surface is essential on land with a slight fall. It must be clearly understood, however, that the leveller does not take the place of the grader or scoop. Grading is cut-and-fill work necessary to make a generally even surface. It comprises the cutting-off of decided hummocks and the filling-in of decided hollows. For steep hillsides grading of this nature is not so necessary, but for flatter country it is essential. The scoop or road-grader is therefore the implement to use for this class of work, and the leveller is intended only to put a fine even finish on the rough preliminary grading.

(To be continued.)

ASHBURTON EXPERIMENTAL FARM.

NOTES ON OPERATIONS, SEASON 1923-24.

F. E. WARD, Instructor in Agriculture, Christchurch.

THE season under review in the mid-Canterbury district may be described as consisting of a wet winter, a very dry spring and summer, and a mild autumn. In consequence of the dry growing-period no heavy cropping can be recorded from the Ashburton Experimental Farm. Poor results were obtained from roots; the cereals, being spring-sown, did not give good yields; and the returns from grass and lucerne were below the average. The Farm Overseer, Mr. J. G. McKay, carried out the work in his usual efficient manner, and has furnished reports from which these notes are compiled

PASTURE.

A field intended for a horse-paddock was sown on 20th March, 1923, with the following mixture per acre: Perennial rye-grass, 6 lb.; cocksfoot, 15 lb.; crested dogtail, 2 lb.; red clover, 5 lb.; white clover, 2 lb.: total, 30 lb. It will be noted that this has a much higher proportion of cocksfoot to rye-grass than is usual under Canterbury conditions, but where permanent pasture is required the mixture as given can be recommended. A portion of this paddock was shallow-ploughed two months earlier than the deep-ploughed parts, and on this portion the grasses and clovers came away much quicker, no doubt due to the effects of weathering. It provides another demonstration of the advantages of early ploughing. A portion of the paddock dressed with 2 tons of carbonate of lime prior to sowing showed no beneficial results from the application. Experiments with lime, both burnt and carbonate, on pasture lands are now being conducted in Canterbury to ascertain the efficacy of such treatment.

Paspalum.—A mixture containing rye-grass, red clover, and paspalum sown two years ago was autumn-grazed, then closed for hay, and subsequently grazed again. The sowing of 5 lb. per acre of paspalum should have produced some plants, even presuming the germination was low, but none has been observed. The writer has observed a few isolated plants in one or two places in Canterbury, but in the main it would appear that the winters are too severe for this grass in the district.

TOP-DRESSING TEST.

A top-dressing experiment was carried out during the winter and spring on a 10-acre pasture. Half the pasture had been sown down with rape in November, 1920, and the other half with grass following rape in April, 1921. The area was divided into seventeen plots, having fourteen treated plots of $\frac{1}{2}$ acre each and three controls of 1 acre each. The following treatments were given:—

Plot 1: Control (no dressings). Plot 2: 5 cwt. burnt lime in July; 2 cwt. superphosphate in September. Plot 3: 10 cwt. burnt lime in July; 1 cwt. superphosphate in September. Plot 4: 10 cwt. burnt lime and 1 cwt. superphosphate in July. Plot 5: 5 cwt. burnt lime and 2 cwt. superphosphate in July. Plot 6: 5 cwt. burnt lime in July; no super applied. Plot 7: 10 cwt. burnt lime in July; no super applied. Plot 8: No lime; 2 cwt. superphosphate in September. Plot 9: Control (no dressings).

The remaining plots were repetitions of those detailed.

With the exception of a light stocking for five days in October, stock was kept off the area till 12th November. Heavy stocking was purposely delayed in order to give the dressings time to act and make any difference between treated and untreated plots more easily discernible. However, no appreciable difference was apparent previous to the heavy stocking in November. It was noted in subsequent growth that on the plots treated with lime and super in July the red clover came away quicker than on any others. In fact, these were the only plots where a difference was noticeable at any time. This fact leads one to think that better results would be obtained if the manures were applied during winter instead of early spring. The dryness of the season must, of course, be taken into account in this case.

The whole of this section was skim-ploughed during February, worked up in March, and deep-ploughed in April. A wheat trial consisting of sixteen varieties, and using College Hunters as a control, is being carried out. In order to note the effect of these top-dressings on a cereal crop the wheat plots have been sown across the top-dressed areas.

DANISH COCKSFOOT.

The area of 2.4 acres previously laid down with Danish cocksfoot in wide drills was again harvested for seed. The area was heavily stocked with sheep during August, 1923. When the stock was removed the cocksfoot was cultivated, and a top-dressing experiment was commenced on 6th September. The area was divided into seven plots and treated as follows: Plot 1, 2 cwt. super; plot 2, control; plot 3, 2 cwt. super; plot 4, control; plot 5, 1 cwt. super, 1 cwt. blood; plot 6, control; plot 7, 1 cwt. super, 1 cwt. blood. Further cultivation immediately followed the application of manures.

The results have been disappointing. Owing to the very dry weather experienced it was decided to treat the experiment as an observation test only. At no time has there been any apparent difference between treated and untreated plots. A greater amount of straw might reasonably have been expected from the treated plots, but this was not evident. The aftermath shows an equal growth on control and treated plots. It was decided not to graze the aftermath during the past autumn in order to note the effect of non-stocking on next season's seed crop.

The seed crop this past season was harvested on 18th December. The threshing-mill would not make a satisfactory job, and the bulk of the stuff was hand-threshed. The amount of seed bagged, including blowings and husks from the mill, amounted to 450 lb., or 187.5 lb. per acre. There will be some difficulty in estimating the exact amount of pure seed produced, owing to the fact that in the case of the machine-threshed sample the kernel was taken out of the chaff. The usual dressing methods would remove this chaff or husk, which should really be added to the seed-weight.

CEREALS.

Wheat.—A variety trial was made on land previously occupied by roots and fodders. The land was grubbed during May and deep-ploughed in June. It was worked with disks and harrows, and the following wheat varieties were sown on 16th and 17th August, 1 cwt.

of super per acre being applied : Velvet Chaff, Marquis, Major, Velvet (Ngapara), Queen Fair, White-straw Tuscan, Red Fife, Zealand, Turretfield Eclipse, Queen Fan, Jumbuck, and Essex Conqueror. Originally 180 varieties of wheats had been tried on the farm, and the foregoing were selected from these.

The varieties now listed had previously been either autumn- or winter-sown, and it was hoped to get some useful information regarding their habits when spring-sown. At least four of these varieties are not suited to spring sowing—namely, Velvet Chaff, Ngapara Velvet, Essex Conqueror, and Red Fife, although the last-named made better growth than the three others. All the varieties in the test are now being used in a trial against College Hunters on Section 4. The varieties Turretfield Eclipse and Queen Fan were affected with loose smut, the latter only slightly. Major, a notoriously bad smutter in some localities, was practically free from smut here.

Short rows of twenty-three wheats and one barley variety from Dookie Agricultural College, Victoria, were sown on a portion of this field, also four varieties from Canada. These will receive a further trial before comment is made on them. The four Canadian varieties were Canada, Bishop, Huron, and Early Red Fife. Three rows of a Solid-straw Velvet, secured by the writer from a crop of Ngapara Velvet, were sown alongside these varieties on 17th September. This Solid-straw Velvet appears to be a wheat that would adapt itself to autumn rather than spring sowing, being a slow grower with a similar habit of growth to Velvet Chaff.

Barley.—A plot of Swedish Gold barley was sown on 3rd October, and yielded 30 bushels per acre. The grain produced was similar in size and general appearance to the sample sown, and was not up to the standard of the varieties usually grown.

Oats.—On a field sown with Garton oats in the spring, with and without superphosphate, the latter at the rate of 1 cwt. per acre gave a marked result. The early growth of the manured areas was remarkable, and kept the fat-hen well in check. On certain unmanured parts the fat-hen was almost as tall as the oats by reaping-time. In comparing samples of seed from manured and unmanured areas on the heavier and the lower-lying lands it was found that the unmanured produced a somewhat plumper sample than the manured. On the lighter soil, however, the samples were about equal, with a bulk of straw and larger heads in favour of the manure.

TURNIPS.

In order to assist the Entomologist, Mr. D. Miller, in his investigation of the "turnip-fly" pest, sowings of turnips were made approximately at intervals of two weeks, commencing on 24th November and ending on 5th February. The varieties used were Fosterton Hybrid, Centenary, Imperial Green Globe, and Hardy Green Globe. Investigation has proved that the grass-grub beetle is responsible for most of the damage done to rape and turnip crops during November and early December. A January-sown crop did not suffer to the same extent as the earlier sowings. January is late, however, for sowing turnips other than the white-fleshed quick-maturing varieties if good yields are to be expected. At time of writing (July) dry-rot is in evidence on the earlier-sown plots, and the bulbs on the later-sown

plots are very small. The diamond-back moth has been at work for some time past. With the dry season and the ravages of insect pests, the crop has been a very light one.

SUGAR-BEET.

An area was sown in sugar-beet with the object of securing information on manuring, rate of seeding, width of rows, and spacing. The seed, which was imported from Victoria, was late in arriving, and in consequence the roots were small. It is intended to write a special note on these trials when weighings have been taken.

POTATOES.

Variety and cut *versus* uncut seed tests were again carried out—one hundred sets of each, fifty cut and fifty uncut. The varieties used and the yields of those dug at time of writing are as follows:—

Variety.	Treatment of Seed.	Yield.		
		Table.	Seed.	Pig.
		Tons.	Tons.	Tons.
Reading Russet	Uncut	7.06	2.80	1.08
"	Cut	6.14	4.48	1.32
Snowdrop	Uncut	2.80	5.36	3.36
"	Cut	1.11	5.26	2.64
Manhattan	Uncut	5.36	2.44	0.84
"	Cut	4.63	2.19	1.20
Dakota	Uncut	5.61	2.07	0.48
"	Cut	6.65	1.70	0.36
Bresee's Prolific	Uncut	2.80	3.55	2.28
"	Cut	2.68	4.60	3.72
British Queen	Uncut	4.39	2.66	0.96
"	Cut	4.02	3.16	1.56
Aucklander No. 3	Uncut	4.63	2.19	0.48
"	Cut	4.02	2.07	0.72
Arran Chief	Uncut	1.58	2.66	1.32
"	Cut	1.09	3.02	1.56
Up-to-Date	Uncut	2.92	1.58	0.84
"	Cut	2.56	1.95	1.32

Total of table potatoes from uncut seed, 37.15 tons; from cut seed, 32.00 tons.

Total of seed potatoes from uncut seed, 25.31 tons; from cut seed, 28.43 tons.

Total of pig potatoes from uncut seed, 11.64 tons; from cut seed, 14.40 tons.

Total of marketable potatoes from uncut seed (table and seed), 62.46 tons; from cut seed, 61.33 tons: Balance in favour of uncut seed, 1.13 tons.

Mr. McKay reports: "The method of cutting the sets for these plantings was somewhat different from that of previous seasons. Usually the sets are cut through from rose to stem end, and both halves are planted, provided that sufficient eyes—two or more—are present in each half. This season the sets were sliced down the side, leaving the rose end intact, and this portion only was planted. It will be seen that the proportion of seed and pig to table potatoes was greatest where cut seed was used. In past experiments the results were in the main in favour of uncut seed. It has been suggested by some growers that the centre eye in the rose end of a potato produces more small potatoes than the others. There may be truth in this theory, as this eye is usually destroyed when potatoes are carefully cut from rose to stem end. In an endeavour to obtain something definite regarding the

relative values of the rose end *versus* stem end as tuber-producers an experiment was carried out here some three years ago. In a good many cases, however, the stem ends rotted in the ground without sending up shoots. The variety used for the test was Arran Chief."

SHEEP-FEEDING TRIAL.

For this trial a paddock was divided into two plots of 8 acres each. Ten ewes per acre were wintered from May onward on one block, with a supplementary ration of lucerne hay; on the other block two ewes per acre were carried without supplementary feed. The lucerne-fed ewes wintered well so far as feeding of dry lucerne was concerned, but foot-scald caused a great deal of trouble, and the ewes had to be moved to other pastures from time to time. It was ascertained that about 3½ lb. of hay per day per sheep was required for food and unavoidable waste. Owing to the ease with which the sheep got their food they lacked exercise, and consequently trouble was experienced at lambing-time. On the grass-only area no difficulties were encountered, either from foot-scald or at lambing, and the death-rate was much lower than that of the lucerne-fed ewes. The lambs of the lucerne-fed ewes were fattened on green lucerne, and those of the grass-fed ewes were sold fat off their mothers. The former were the bigger lambs when dropped, but when fattened there was little to choose between the two lines.

LINSEED.

Two varieties of linseed imported from Canada—namely, Ottawa 53 and Premost—were tried, but an excessive growth of fat-hen militated against a satisfactory yield. The quality of the linseed produced was not superior to that of the varieties in common use here.

LUCERNE.

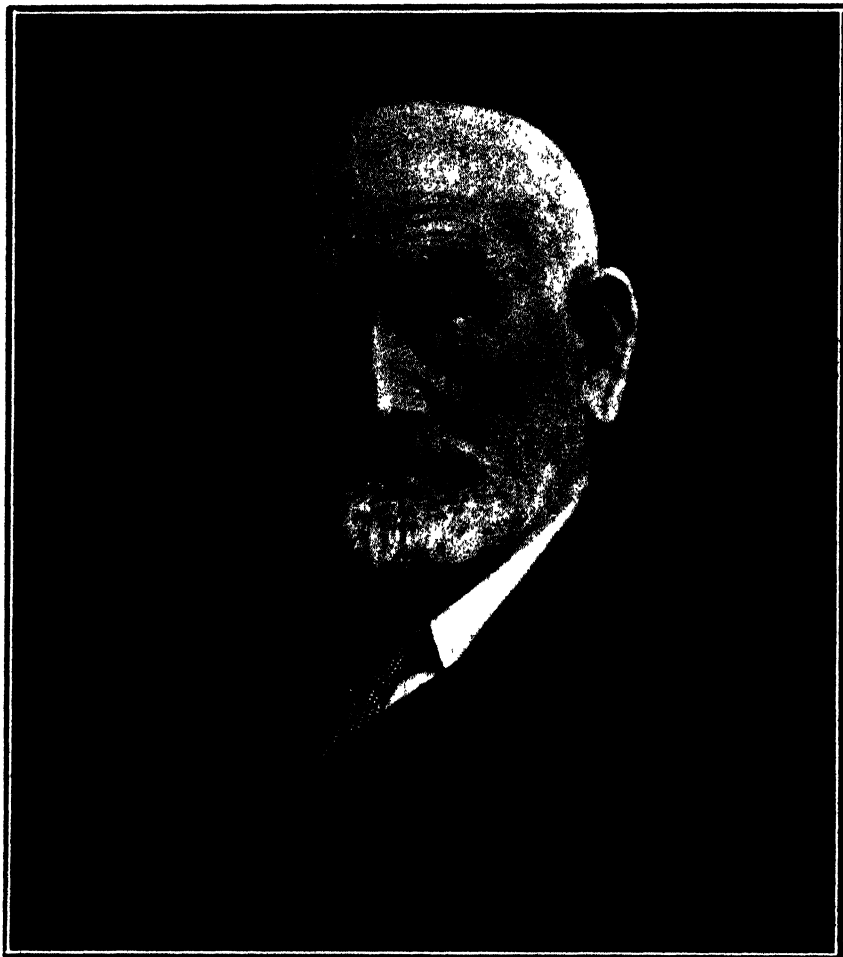
The established areas of lucerne were used for hay and grazing. The spring yield of hay was good, but the dryness of the summer was responsible for very light yields in subsequent cuts. The areas grazed were in some cases fed off six times during the season without any apparent injury to the stand. The cultivation of the wide-rowed areas was reduced to a minimum; it seems evident that summer cultivation does not pay. Any increased yield that might result from summer cultivation would not compensate for the cloddy condition of the hay harvested, nor pay the cost of working. Thorough cultivation in the autumn and spring, however, is strongly advocated.

MISCELLANEOUS.

The orchard served a useful purpose in providing instruction in pruning and spraying to the boys of the Ashburton High School and Technical College, the instruction being given by Mr. L. Paynter, Orchard Instructor in Canterbury. Throughout the year the boys have received practical instruction in general agriculture from Mr. McKay, who has also demonstrated the uses of the various farm implements.

A small area in the orchard section sown several years ago with *Phalaris bulbosa* now forms part of the horse-paddock. This grass is evidently quite permanent on the low-lying places, where it makes abundant growth.

THE LATE SIR WALTER BUCHANAN, M.L.C.
1838-1924.



PIONEER SETTLER AND PROGRESSIVE FARMER. FOUNDER OF THE CHAIR OF AGRICULTURE AT VICTORIA COLLEGE, WELLINGTON—THE FIRST AGRICULTURAL CHAIR UNDER THE UNIVERSITY OF NEW ZEALAND.

The Chair, now occupied by Professor G. S. Peren, was established by the foundation gift of £10,000 made by Sir Walter Buchanan last year, and since subsidized, pound for pound, by the Government.

SEASONAL NOTES.

THE FARM.

TILLAGE OPERATIONS.

LAND intended for the coming season's root crops should be given a second ploughing before the end of September, or as soon as soil conditions are favourable. From then on till sowing-time the soil should be stirred occasionally, with the object of killing weeds and ensuring a mellow tilth. Owing to the prevalence of club-root in turnips it is advisable to keep this crop as far apart as possible in the rotation.

Areas selected for potatoes—which would be preferably out of lea, skim-ploughed early—should now be cross-ploughed deeply as soon as conditions permit, and thoroughly stirred with the cultivator from time to time. It is better not to work the old sod down to a very fine tilth, so long as it is well broken. Potatoes are very partial to a somewhat open free tilth, which is usual after grass. Work should be regulated with the object of planting towards the end of October for the main crop. The seed should be carefully picked over as opportunity offers, and only good sound seed of even size (about the size of a hen's egg) selected.

Land for rape should be further prepared as occasion permits with the object of making a first sowing on warm land with a northerly aspect from the middle of October—weather permitting—and the main sowing early in November. Rape is a crop which repays good tillage.

In the North Island light fern-country is often ploughed in September, as the young fern-shoots are then very vulnerable. This land is generally sown with either rape or turnips in November and December, but it is good practice to plough now and give a second ploughing or thorough disking shortly before sowing. Where fern is troublesome on established grasslands a good harrowing with the heavy tripods will do good work by bruising and breaking the young fronds.

SPRING SOWINGS.

September is a good month for sowing special crops for hay or ensilage, Algerian oats with tares or peas being about the best at this time. A mixture of 2 bushels of oats and 1 bushel of tares or $1\frac{1}{2}$ bushels of peas per acre may be recommended. Either variety of tares will do, but Golden are the best for spring sowing, while Grey Partridge and Early Minto are suitable varieties of peas. This type of crop may also be used for feeding out green. Super or basic super, 2 cwt. to 3 cwt. per acre, are suitable fertilizers. Italian and Western Wolths rye-grass and cow-grass make another fine class of hay, using 15 lb. of each as a mixture with 5 lb. or 6 lb. of cow-grass per acre, or 30 lb. Italian with the same amount of cow-grass.

Oats and mustard sown now make a good bite for ewes and lambs before the rape is ready. About 6 lb. of mustard per acre may be sown with the oats.

In Canterbury it has often been found that the germination of the mangold crop is adversely affected by dry conditions resulting from late sowings. Sown in September the young plants have a better chance of establishing a good root-system before the usual drying nor'-westers make their appearance, and are thereby better enabled to withstand a dry season. Whether the crop is sown in ridges or on the flat must depend on local conditions, wetter areas being more suited to ridging. If amount of moisture is likely to be a serious limiting factor to growth it is advisable to sow on the flat. Recent experiments show that, besides requiring less work, the yield on the flat in Canterbury has usually been the heavier.

Cereals for threshing or chaffing were dealt with last month.

CLOSING FOR HAY.

Meadows intended for hay or ensilage should be thoroughly fed down, well harrowed to ensure a clean bottom for the mower, and shut up at the end of September or early in October. If not already done the ground should be top-dressed with super or basic super, at 2 cwt. to 3 cwt. per acre. By shutting up early the farmer is enabled to get the hay crop cut early, which allows a better growth of aftermath before the dry, hot weather sets in, this being important if good summer and autumn feeding is desired. The early-cut hay crop is usually of much better quality than the late crop, but the date of closing is really the controlling factor in securing the proper admixture or proportion of clovers to grass. Very early closing means a higher proportion of grass to clover, whereas late closing means the reverse, so that the aim should be to close at a time which previous experience has shown will result in sufficient clovers being present.

LUCERNE.

The land will be warming up in September, and rapid growth may be expected towards the end of the month. This is the time to carry out spring cultivation where necessary. It should be clearly understood, however, that lucerne should never be cultivated in wet weather or when the land is wet. If the conditions are not suitable it is much better to delay the cultivation until after the first summer cut has been removed. The object of spring cultivation is to break the surface of the land which has become hard by grazing or by frequent rain, and allow the air to get in, also to shake up weeds and grasses that have become established.

The field to be treated should be grazed off quickly, or cut and the material raked off, before cultivation is attempted. If the land has been well cultivated during the past season, and is fairly free from grass, cultivation is simple and can be carried out by any of the ordinary cultivators fitted with lucerne points; in some cases the tine harrows weighted with a few sacks of earth will do all that is necessary. On the other hand, if cultivation was neglected and the land has become badly infested with grass the treatment must be more drastic. If the cultivator is used first large lumps of grass are dug up, and great difficulty is experienced in breaking these up sufficiently to get the land in decent order for the mowing-machine. In cases of this sort better results are obtained by giving the land one or more strokes of the disk to cut the grass into small lumps,

after which the cultivator or harrows may be used to shake it up. Care should be taken to run the disks as straight as possible, but it will be found that in some cases a little cut is necessary to bring about the desired result. Spring cultivation—in the North Island, at least—cannot be expected to kill many weeds, but if done at the right time the subsequent growth of lucerne will be heavy enough to smother most of the undesirable growths. Where it is necessary to top-dress, this should be done simultaneously with the spring cultivation, using superphosphate at from 2 cwt. to 3 cwt. per acre. The stand should have been well limed previously.

Where it is intended to establish lucerne during the coming season preparation of the land should be continued. Any crop being grown for green manure should be turned under at once; if left later it will not have time to rot thoroughly before the lucerne-seed is sown. Unless such a crop can be turned under in September it is best to feed it off with stock and turn the droppings under. Lea land should be ploughed fairly deep and the surface kept worked to destroy weeds. The same applies to land that has just grown a crop; it should be ploughed, and the first few inches of soil kept continuously stirred up till time of sowing, in order to germinate and destroy weeds. If carbonate of lime is being used, this should be applied as soon after the ploughing as possible, at the rate of from 10 cwt. to 20 cwt. per acre.

TUSSOCK - BURNING.

In the back country of the South Island a heavy growth of aged tussock is to be seen at various places. This should be burned during the coming month, and the work of surface-sowing with suitable grasses put in hand.

—*Fields Division.*

THE ORCHARD.

At this season of the year it is perhaps necessary to emphasize the necessity for all orchard-work to be kept well in hand. A good start is half the battle, and things done at the right time make for success. It is necessary to have all pruning completed as soon as possible. This will enable growers to carry out the other seasonal operations as they become due, such as spraying, cultivation, grafting, &c.

SPRAYING.

As mentioned in last month's notes, this work will need attention as each variety of fruit arrives at the correct stage when spraying is most effectual. Every care should be taken to cover the whole surface of the trees, including trunk, branches, and laterals. This can only be done in a satisfactory manner by spraying from each side of the tree. Three things are necessary for the work to be successful: First, good material; second, thorough and careful preparation; and third, careful application. Details of spraying at this time of year were given in last month's notes.

CULTIVATION.

Spring and early summer, when the trees are making growth, is the proper time for cultivation to be done. If the land has been turned over during late autumn or early winter it can be cross-ploughed during early spring with great advantage. If ploughing has not been carried out no time should be lost in pushing on with this work. It is bad practice to interfere with the soil when it is wet. After ploughing, the soil should be worked down to a fine tilth; this will enable the moisture to be conserved should the early summer be dry. This part of the work should receive attention at various times onward till about the New Year, when all cultivation should practically cease. The greater part of the wood-growth is made during this period, and it should not be stimulated any longer, autumn being the time when all wood-growth should ripen if it is to carry out its functions during the following year. Every care should be taken when cultivating not to damage the trees.

GRAFTING.

It often happens that varieties are not doing well or are unsuited to the requirements. These can be reworked with more suitable kinds. The trees will not be ready for this work until the end of September or early in October. The scions, however, should be selected during pruning operations. They should be selected from the trees that are healthy and vigorous and free from diseases, and, moreover, showing good cropping-qualities. The scions should be kept in a cool place until they are wanted. The best results are obtained when the stock is in advance of the scion.

There are several methods of grafting—bark, cleft, and whip-and-tongue grafting being the most commonly used. The method to be followed depends largely on the age of the tree to be grafted. On trees from about three years and upwards bark-grafting is usually practised, and is quite a simple process. The lower part of the scion is pared down, the bark of the stock drawn slightly away from the wood, and the scion then pressed in. It is necessary to bind the grafts firmly with raffia, string, or flax. They must then be covered to exclude the air. Formerly this was effected by means of a thick coating of clay, but waxing is almost universal now.

—L. Paynter, Orchard Instructor, Christchurch.

CITRUS - CULTURE.

The work of pruning all citrus-trees should now be pushed forward as rapidly as possible in order that it may be completed before the full flow of sap, which occurs just previous to the spring blossoming. Since writing the notes for last month's *Journal* very much further infection from brown-rot on both orange and lemon trees has been noticed in almost every part of the Auckland District. On account of this it is as well to emphasize the remarks made last month regarding the removal of the lower branches from trees where excessive growth has occurred, causing same to sweep on the ground or to be so placed as to prevent a free current of air through the trees. The brown-rot spores develop on the ground, and it is therefore essential that the treatment advised regarding pulverized sulphate of iron

should be carried out as soon as possible. Should the weather become much warmer during the latter part of August, spraying for the control of sucking-insects by the application of red oil, 1-40, should be carried out. However, in most localities it is probable that this spray would be more efficient if delayed until the first or second week in September.

—J. W. Collard, *Orchard Instructor, Auckland.*

POULTRY-KEEPING.

THERE should now be no delay in getting the required number of chickens hatched out before the end of September at the latest. The correct season for bringing out chickens extends over a very short period, and the end of September may generally be taken as the end of this correct season. Chickens hatched too soon—say, early in July—mostly moult just when high-priced eggs are expected. On the other hand, if the hatching is delayed until November or December the chickens seldom grow to a desired size. This not only means that they will in all probability lay small-sized eggs, but such stock also are always more susceptible to colds, roup, and other diseases than those hatched at an earlier period.

INCUBATOR TROUBLES

Many inquiries have reached me lately as to poor results and troubles encountered in the work of artificial chick-production, but, with few exceptions, the correspondents failed to give the name of the particular make of machine they are using. In the circumstances it is next to impossible to even suggest the probable cause of the trouble. There are now so many different styles of incubators and brooders in use, together with varied methods of working them, that any definite instructions given in these notes could not be applied generally. Correspondents when asking for advice regarding the troubles they encounter should always give the name and the particular style of the incubator or brooder they are using. Without these particulars it would be merely guessing on my part to express an opinion as to the probable cause of failure.

POINTS IN BROODING.

Even in the best-managed plant where artificial methods are employed for the hatching and rearing of chicks some losses during the brooder stage are inevitable. Generally the greatest loss takes place towards the end of the hatching season, when the days are gradually getting warmer. Much of the mortality could be avoided by amending the methods of applying heat and ventilation in the brooder in accordance with the prevailing weather conditions. It is common for poultry-keepers to work their brooders in exactly the same manner in October and November as during, say, July and August, when heavy frosts are often experienced. This is a mistake. It should be remembered that during the early season the weather conditions are more uniform than is the case later; therefore the desired degree of temperature and ventilation demanded by the chicks in the brooder can be easily controlled. With the approach of

summer, however, extreme variations of climatic condition are often experienced, and it is these that have to be guarded against. It frequently happens that a hot night follows a cold one, and this is where the chief danger lies, mainly because the chicks become overheated at night, and in leaving the brooder next morning the extreme change of temperature proves too much for them, resulting in chill and its attendant troubles—white diarrhoea, droppy wings, &c. Once chicks become thus affected it is useless trying to doctor them, nor even if they are reared they seldom or never make really profitable stock. The wise poultry-keeper usually destroys such stock at the outset.

To prevent chill, the brooder should be maintained at a more or less uniform degree of temperature, but it should be so arranged that the chicks can secure a variation of warmth. In this way they are given an opportunity to move away from the heat when it is excessive, which frequently happens on a hot night. That overheating and insufficient fresh air are common causes of chill and mortality is borne out by the fact that during hot weather chicks, even when at a comparatively young age, will invariably thrive better if removed from the brooder to a colony house. No doubt this is chiefly due to the increased amount of fresh air which is made available to them. It is, however, not suggested that the chicks should be hardened off at a very young age, as this often means a check in development, and serious losses. They should be well brooded, but care should be taken to provide the desired degree of warmth and fresh air at all times. The behaviour of the chicks at night is the best guide as to whether they are comfortable or not. If the chicks are well spread out it may be taken for granted that the heat being maintained is correct, but should they appear to be huddling, then more heat is required. The spreading of the chicks should at all times be studied as well as the thermometer.

As to huddling, complaints have reached me regarding chicks crowding in corners of the house when being reared with colony-brooder stoves. I attribute this largely to the presence of a ground draught, and not excessive heat, as is usually supposed to be the cause. In working this class of brooder, provision for the admittance of an ample supply of fresh air is imperative, but this must be provided without draught. If there is a draught from any particular quarter the chicks will gradually move away from it until a corner is reached, indicating that they prefer to leave the chief source of heat (so essential for their welfare) rather than remain in the draught. They feel the need of the desired warmth, with the result that they crowd in corners, each trying to secure an inside position, which is, of course, the warmest. The huddling brings on a sweating condition, and this is fatal to chicks at any time. As a preventive I would advise placing on the floor of the house a board, say, 1 ft. high, a few feet away from the brooder, as a draught-break. If the behaviour of the chicks is observed it will soon be detected from which direction the draught is coming, so that the board or boards, as the case may be, can be placed to break the draught. Of course, care must be taken that the chicks are given sufficient space to move well away from the heat when this is excessive, especially when warm-weather conditions prevail. The boards should not be moved out

till the chicks are well settled down for the night. Even then they will be less disturbed if this is done in semi-darkness.

—*F. C. Brown, Chief Poultry Instructor.*

THE APIARY.

BREEDING.

WITH the advent of September, colonies in a normal condition should have a good quantity of sealed brood. If, however, the absence of brood is noted, the indications point to a poor queen or that the hive is queenless. To attempt to carry such colonies through the spring months will lead to serious trouble, as they stand in danger of getting robbed out. It is a far better plan to unite such colonies than run the risk of disturbing the whole apiary. A simple method of disposing of weak and queenless hives is to unite them with strong ones, and this may be carried out by placing a sheet of newspaper over a strong colony and putting the hive to be united on the top of the paper. In the course of a day or two the hive may be examined to see that the colonies have united. Should the paper be intact it must be torn in several places, when it will be found in the course of a few days that the colonies are working peaceably. It is essential that breeding should be kept steadily going, so that the colonies will be strong in young bees to take advantage of the first flow of nectar. Food and warmth are important factors in inducing breeding, and these must have the constant attention of the beekeeper during the spring months.

FOOD - SUPPLY.

The spring is the most critical period of the year for the beekeeper, and the success or otherwise of the season's work will depend almost entirely upon his efforts to guard against the losses attendant upon starvation. Large losses occur annually through neglect in this direction. When breeding is in full swing a considerable amount of food is used up daily for feeding the brood, and, unless the weather conditions are favourable to enable the bees to work the early spring blossoms, it is essential that the food-supply be augmented. The amount of nectar gathered when the weather is favourable, in conjunction with their stores, will tide the bees over long periods, but if bad weather follows, colonies will often be reduced to a state of starvation before the owner is aware of their condition. If on examination a colony is found with insufficient stores to meet requirements preparation should be made to feed at once. It is not a safe policy to keep a colony at starvation-point, as this will prevent the rearing of a succession of young bees to take the place of the rapidly dwindling number of workers at this period.

There are many feeders on the market which can be utilized for the purpose of supplying food. The division-board feeder is the best to use at this season, as it will serve the double purpose of feeder and division-board in cases where the colony is not strong enough to occupy all the frames in the hive. When making an examination of a hive to note its condition the feeder should be placed in the hive in readiness if it is anticipated that artificial feeding will have to be

resorted to at a later period. All feeding should be carried on within the hives. Especially guard against feeding at the entrances, as that will surely produce trouble. Place the feeder on the warm side of the hive, and in cases where the clusters are small the feeder can be inserted in position next to the cluster.

A point to remember in connection with feeding is that it creates an artificial flow and is stimulating, and, when started, it must be carried on until a natural flow from the fields sets in. If there is a suspicion of disease in the apiary, do not attempt to feed honey. In any case it is not wise to use honey taken from another hive, as it is impossible to be sure of its source. Feed only the best white sugar. It is a good plan to feed in the evening, as the discovery of the syrup excites the bees, and the colony has time to settle down before the morning, and there is less likelihood of the other colonies learning the cause of the excitement. A syrup composed of two parts of water to one of sugar, fed slightly warm, will prove the best artificial feed for bees in the spring.

ROBBING.

Every precaution must be taken to prevent robbing getting a start in the apiary. Robbing may be caused by exposing combs too long when manipulating the hives, by careless feeding, and by the presence of weak and queenless colonies. These latter should not be tolerated, and the other causes can be obviated by care and attention. On no account should combs be exposed for long intervals, and if feeding has to be undertaken it should be deferred until late in the day. The excitement caused by feeding attracts other bees, and once they have tasted of the forbidden sweets they will continue to molest the hives for many days. As soon as robbing is detected it is far the best plan to postpone all operations in the apiary, and the entrances to the hives should be contracted at once. If a colony is in danger of being robbed it may be saved by piling wet grass in front of the entrance. Robbers are less likely to enter a hive so protected. Very little trouble, however, will be experienced by robbing if it is not allowed to get a start; prevention is the best plan in all cases. On no account spill syrup near the hives; do not leave combs lying about; and try to avoid weak and queenless colonies. One will then not be troubled with robbing.

DISEASE.

At each examination a strict watch must be kept for symptoms of foul-brood. If it is present, do not fail to mark colonies for treatment. Mild cases can be treated at a later period in the season, but if a colony is badly affected it is by far the safest plan to sulphur the bees and remove the combs to a place of safety. These combs can be converted into wax when a sufficient number warrant the undertaking. If isolated capped cells are discovered, these should be treated as suspicious. Healthy brood-cells are convex in form, bright in appearance, and in contrast differ greatly from diseased cells. These latter are slightly darker, concave in form, and are frequently perforated. Diseased cells of last season's production are usually so shrunken in appearance as to be easily detected, whether they are in isolated positions or surrounded by healthy brood.

—E. A. Earp, Senior Apiary Instructor.

THE GARDEN.

VEGETABLE-CULTURE.

URGENT work at the present season is the timely hoeing of seedling crops, the success of which depends very largely on this being done properly. Before the seedling weeds develop their second leaves the hoe should be put through them on a fine bright day, and they will be quickly disposed of. As soon as the young shoots indicate the rows in the potato crop a similar attention should be given, and a great deal of work that is a real drudgery will be avoided. Land that has carried winter crops of cabbage and broccoli should be cleaned up and cultivated as soon as it is available, and sown in root crops or planted in potatoes.

Now is the time for sowing the main crop of carrots, beet, and turnips; also celery, peas, spinach, silver-beet, and sa'lads. In the colder sections with a fair rainfall, cabbage for autumn use may be sown; a little red cabbage may well be included. In more favoured areas aubergines (egg-plants) and capsicums may be sown and raised in heat. Like the tomato-plant, they are half-hardy annuals, and require somewhat similar conditions. Their growing popularity is well deserved.

The preparation of land for tomatoes and other late-planted outside crops should be completed as soon as possible and kept in clean fallow. This affords an excellent opportunity for cleaning land, and saves a lot of work later. Reserve a piece of rich land in a cool locality for a seed-bed for winter crops, preparing it now for sowing later.

Land that has been prepared for asparagus may be planted now. The old system of crowding the plants is unsatisfactory. Large areas are now planted in rows or clumps 3 ft. or 4 ft. apart, but for ordinary purposes rows alternately 18 in. and 3 ft. apart will be more generally satisfactory. Obtain two or three-year-old plants and handle them with care. Open out a liberal trench for planting, and place them so that there is finally 5 in. of soil over the crowns. Cover them with 2 in. or 3 in. of soil at present. Hoe the land over occasionally before seedling weeds reach any size, and allow the plants to be gradually covered to the full depth. There should be no cutting of young sticks made this season, and very few next. Established beds of asparagus should receive a dressing of nitrate of soda; 2 oz. to the square yard will be usually sufficient at the present time. Beds on light land may receive a dressing of common salt a little later. Rhubarb beds that are being cropped should also have a dressing of nitrate of soda, 1 oz. to the square yard being sufficient.

Where tomato-plants are grown under glass care should be taken to see that not only is the ground prepared, but that the house is free from the infection of plant-blight. The experience of the past season will guide one in this matter. Where leaf-mould has given trouble the spores will be general throughout the house, and the crop will be more easily handled if they are destroyed before planting. Even the strings should come in for consideration where the attack has been bad. Bluestone solution, 1 lb. to 25 gallons of water, is a good fungicide for this purpose. Flowers of sulphur are sometimes burnt in an empty house before planting—1 lb. to 1,000 cubic feet being used,

and the house kept closed for twenty-four hours. Carefully examine each plant before setting it out to see that it is true to type and free from disease. After planting, houses are best kept warm by early closing, and on the dry side, till the first bunch of fruit is set.

SMALL-FRUITS.

Land prepared for passion-vines may now be planted. It should be clean, in good heart, and sheltered. The rows—running north and south—should be 10 ft. apart, and the plants 12 ft. apart in the rows. To support the vines, posts standing 5 ft. out of the ground should be placed at intervals of 24 ft., and along the tops of them two No. 8 wires should be strained side by side and about 6 in. apart. The young vines should be trained to a single stem by stopping all laterals and tying them to stakes till they reach the wires above, when four laterals are allowed to grow out and are trained along the wires each way. These form main leaders from which fruiting-laterals are grown. To keep these plants carrying heavy crops generous manuring must be maintained. Old vines should now have the fruiting-laterals pruned back to the two base buds.

Breaks of Cape gooseberries which cropped last year may now be cleaned up and given a dressing of chemical fertilizers, and the land between the rows turned over by shallow ploughing, followed by light harrowing. Established strawberry beds will also require a good dressing of manure, working it in with a light cultivator. Attend well to any necessary spraying, and keep the cultivator busy during fine dry weather. This also applies to breaks of gooseberries, raspberries, and currants as well as the preceding. Land to be planted out in Cape gooseberries next month should now be getting thorough preparation.

There has been some inquiry regarding the growing of loganberries. Those deciding to plant should get their plants in as early as possible now. Heavy land in a sheltered locality is required for good results. Large areas are usually planted 8 ft. between the plants both ways, and small plantings rather closer. The canes are usually trained on a wire trellis supported on posts 5 ft. out of the ground and placed at intervals of 30 ft., two wires being strained on them at a distance of 2 ft. and 4½ ft. from the ground. Plant deeply, and aim to get a strong growth of canes the first season.

TOBACCO-CULTURE.

If the tobacco-seed beds are not yet started a commencement should now be made without delay. It is as well to make two or three sowings at short intervals, and thus have plenty of plants and provide for all contingencies. Keep the beds free from weeds and thin out the plants where necessary. The beds must not be allowed to dry out, but when the plants are half-grown it is as well to keep them rather on the dry side. Although this crop does not require the heaviest land, it requires the best of preparation, and if the area to be planted is not yet ploughed up a start should be made at once. The cultivation should be of the best, and the land cleaned by frequent working. If the land is at all sour an application of lime should be made and worked in.

Those who are holding last season's crop should now bulk it down. This is done by placing two rows of hands, overlapping by about one-third of their length, with the butts outward. Build up in this way to a height of 3 ft. or 4 ft. Weights should be placed on the top of each bulk, which should be covered with a tarpaulin, the object being to conserve the heat and moisture and avoid drying out the leaf, as well as keeping it in darkness. For this operation the leaf should not be moist, but in such condition that the tips can be squeezed together without breaking and that a slight shake will release one from the other. Examine the bulk daily for a while, and, if found too warm (over 100° F.), it should be broken down, aired, and restacked. The product improves with age if kept under proper conditions.

SHRUBS, LAWNS, DRIVES, ETC.

The planting of trees, shrubs, and perennial plants should now be completed. This is specially urgent on light land in the drier districts. The same expedition is required where lawn-grass seed is to be sown. Secure a firm, even, properly graded seed-bed, and sow it down now as soon as the weather permits.

Grass on playing-greens will now be making considerable growth and will require cutting. Where the grass is young, autumn-sown, or mostly young (through resowing and top-dressing), it must be cut with care. To cut it down hard is to lose it. A perfect and fast-playing surface cannot be expected the first season under ordinary conditions. Follow up the cutting by rolling and cross-rolling the lawns.

Yards, walks, and drives at this season are often disfigured and the surface drainage interfered with by the growth of grass and weeds at the sides and in the water-tables. Where any extent has to be dealt with, hand hoeing is costly and spoils the surface. A weed-killer mentioned, among others, in the *Journal* for May, 1922 (page 304), will be found effective for this purpose, and it should be quite safe if handled by an adult. It is composed of 1 lb. arsenic and 2 lb. caustic soda placed in a kerosene-tin three parts full of soft water. After a few days the arsenic and soda will have dissolved. Stir the solution well and dilute it to 40 gallons, when it may be applied through a rose watering-can.

In such a climate as is enjoyed by New Zealand, pot-plants of different kinds are in great demand for furnishing the airy rooms, verandas, and balconies of domestic and business houses. Be the position ever so dry and sunny or shaded, plants of some kind may be found to suit it. Quaint succulents—cacti and aloes—enjoy the former, while ferns, hydrangeas, fuschias, bays, and many other shrubs prefer the latter situations. Properly catered for, such plants require but little attention if rightly placed. The present is the proper time for potting up such subjects, or repotting those which have overgrown their position. Most of them would benefit by the removal now of some of the old top soil and replacing it with a similar quantity from a good properly prepared compost. Let the rim of the pot or tub stand an inch or two above the soil to allow for watering.

—W. C. Hyde, *Horticulturist*.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

MARE WITH INTERNAL PARASITES.

"SUBSCRIBER," Otane :—

Kindly advise me how to treat a draught mare, eight years old, low in condition, scouring badly, and passing small thread-worms $\frac{1}{2}$ in. long and red in colour. I have given two doses of linseed-oil and turpentine, but the mare continues to scour and pass worms.

The Live-stock Division :—

Your mare is evidently suffering from parasitic infection. The prognosis in all cases is unfavourable, but particularly so when scouring has set in. In treatment the first essential is rest. Ordinary worm medicines are of little use, as their dilution is too great when mixed with the bowel-contents. Boiled milk, gruel, and similar food should be in the daily diet, particularly where diarrhoea is present. The following drench, given in a pint of milk each night and morning, is recommended: Ferri. ammon. cit., 1 dram; quin. sulph., 15 gr.; acid. hydrochlor. dil., 15 minims; tinct. nux. vom., 20 minims. It will be well not to graze your horses in wet or marshy paddocks.

POISONING SPARROWS.

"SUBSCRIBER," Rotherham :—

Sparrows are at present doing much damage to oat stacks, and I should be glad to have a satisfactory receipt for poisoning them. I have bought and tried two different brands of poisoned wheat, both of which kill yellowhammers, green finches, &c., but the sparrows appear to be too cunning to take the poison. This seems to be the experience of most other people with whom I have discussed the question.

The Fields Division :—

The following is a method which has been found effective in killing sparrows in Canterbury: Moisten 12 lb. of wheat with milk, and add 1 oz. of finely powdered strychnine. The birds should be fed with ordinary wheat for a few days before poisoning. Spread the grain immediately after treating it with the poison, and only in the places where the birds have already been fed.

PRUNING OF THE ISABELLA GRAPE-VINE.

"A. M.," Pukehou :—

Please advise me of the pruning of the Isabella grape-vine, outdoor-grown. I understand it needs different treatment to European vines.

The Horticulture Division :—

The Isabella grape-vine, being a very vigorous grower, will cease fruiting after a few years if its natural growth is restrained by pruning on the Guyot or rod-and-spur system. This variety requires a much greater freedom of growth. It can be grown on an espalier having the bottom wire 18 in. from the ground, two wires (one on either side of the posts) 9 in. higher, and two more 1 ft. higher. The laterals are packed in between the double wires as they grow, instead of tying them to single wires as on the ordinary espalier. A distance of from 12 ft. to 20 ft., according to the richness of the soil, should be allowed between the vines in the rows, and 8 ft. between the rows. Two permanent rods should be grown from the main stem, and the laterals pruned back yearly

to the base bud, forming spurs about 9 in. apart. If only a few vines are grown, more fruit can be obtained by growing permanent rods radiating from the main stem and spur-pruning them as above. The rods can be supported on forked sticks, and their number increased gradually from laterals as the vine increases in strength. To work the soil after pruning, the sticks can be withdrawn and the rods placed on one side. Summer pruning should be confined to pinching back the laterals to six or eight leaves above the bunches a little before the flowers open.

LUCERNE-GROWING IN HATUMA DISTRICT.

H. P. HOLE, Hatuma :—

I should be glad of advice about the growing of lucerne in this locality. Mine is limestone-country, but the flats where it would be most convenient to grow lucerne have an iron-sandstone pan about 8 in. below the surface. Water is inclined to lie on the surface in the winter, and the ground is baked hard in the summer, when it almost needs a crowbar to sink a post-hole. There are no creeks or streams in the paddocks. I presume that lucerne would grow for a while if the ground was clean and well limed, but would not establish itself and last for years.

The Fields Division :—

The conditions described are very common in the Hatuma and Waipukurau districts of Hawke's Bay, and it is very inadvisable to attempt the establishment of lucerne on such land. The roots will not penetrate the hard-pan, and the water-logged state so common under such conditions will kill the plant during the winter. Lucerne may be encouraged to grow for two or three years, but the initial cost of establishment, combined with the inferior crop which is sure to result, makes it a very expensive proposition.

DESTROYING GUM-TREE STUMPS.

A. L. FROST, Huapai :—

Gum-trees when cut down to the stump shoot up again. Kindly advise me as to the simplest and best method—without digging up the roots—to kill same.

The Horticulture Division :—

Some species of gums—blue-gum more especially—will shoot from the stump when a tree is felled. This tendency, however, is much less pronounced if the tree is cut down in summer. To destroy the stump without digging or using explosives the following method is usually successful: In the autumn bore one or two holes of 1 in. diameter and about 18 in. deep in the top of the stump, and put in each 1 oz. to 2 oz. of saltpetre; then fill the holes with water and plug up close. In the ensuing spring take out the plug, pour in a small quantity of kerosene and ignite it, and a good burn should result. The stump must be in a fresh, sappy state when the saltpetre is put in, or it will not penetrate the fibres thoroughly.

BACON BECOMING HARD.

"SUBSCRIBER," Papakura :—

Can you please tell me how to prevent bacon, especially the lean meat, from becoming hard after a little while? We usually kill our own bacon and cure at home, using mostly salt and some sugar. Being but a small household, it is some time before the last is used, and usually it is then very hard.

The Live-stock Division :—

It is possible that your cure has been too hard—that is, the meat is allowed to remain in salt too long, especially when sides or pieces are small and thin. Shrinkage is taking place all the time after curing, and a certain amount of hardening in the lean is bound to occur when the bacon is kept for some time. You are advised to avoid using maize or beans when feeding for bacon, as these have a hardening tendency with the lean, but an opposite effect in regard to the fat.

WEATHER RECORDS: JULY, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE weather during the month of July was on the whole very dry, especially in the east-coast districts of both Islands. New Plymouth and Patea were the only places in the table of the North Island showing falls above the average for the month. In the South Island Westland and Otago had rainfalls above the average, but Dunedin and Invercargill were below.

Barometric pressure was very high from the 8th to the 11th, and on the whole rather higher than usual. The days were generally fair and sunny, but the nights were frequently cold and frosty. Auckland experienced one frost, on the morning of the 26th, but parts of Canterbury had frosts on twenty-five nights in the month. In the Wairarapa and some other parts of the North Island from twenty-two to twenty-three frosts occurred, and Wellington had fourteen.

There were two very cold spells—one from the 3rd to the 6th, and the other between the 20th and 25th. The latter period was marked by heavy southerly winds, which arose from the development of a storm eastward of New Zealand. Snow fell during these two periods on the high country of both Islands. Excepting for these two disturbances, the winds were generally moderate and of a westerly tendency.

—D. C. Bates, Director.

RAINFALL FOR JULY, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitaia	2·78	13	0·58	5·96
Russell	2·63	11	0·94	4·26
Whangarei	3·52	19	1·11	8·33
Auckland	2·96	17	0·70	5·05
Hamilton	3·10	15	0·76	5·24
Kawhia	2·66	12	0·62	6·86
New Plymouth	6·98	18	1·51	6·35
Inglewood	9·74	17	2·03	9·93
Wangamomona	6·94	15	2·28	7·68
Tairua, Thames	3·00	11	0·90	5·15
Tauranga	2·91	11	0·66	4·94
Maraehako Station, Opotiki	3·06	10	1·28	4·45
Gisborne	1·64	12	0·38	5·21
Taupo	3·06	10	0·86	4·21
Napier	1·27	6	0·59	3·82
Maraekakaho Station, Hastings	1·54	11	0·62	3·65
Taihape	2·08	16	0·55	3·33
Masterton	1·70	16	0·49	4·43
Patea	6·75	12	1·81	4·10
Wanganui	2·43	7	1·00	3·63
Foxton	3·12	9	0·82	3·26
Wellington	2·97	14	0·52	5·05
<i>South Island.</i>				
Westport	7·37	19	0·95	6·99
Greymouth	8·82	20	2·05	8·43
Hokitika	10·46	19	2·74	9·10
Arthur's Pass	12·18	12	4·56	12·53
Okuru, Westland	12·30	12	2·56	12·03
Collingwood	8·24	13	1·78	9·65
Nelson	3·49	10	1·60	3·47

RAINFALL FOR JULY, 1924—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average July Rainfall.
<i>South Island—continued.</i>				
	Inches.		Inches.	Inches.
Spring Creek, Blenheim ..	1.99	9	0.56	3.93
Tophouse ..	4.39	9	1.03	5.65
Hanmer Springs ..	1.47	8	0.35	5.15
Highfield, Waiau ..	0.70	6	0.22	3.63
Gore Bay ..	1.63	8	0.53	3.31
Christchurch ..	1.49	10	0.72	2.77
Timaru ..	0.28	6	0.14	1.95
Lambrook Station, Fairlie ..	0.82	3	0.42	2.72
Benmore Station, Omarama ..	2.07	13	0.65	1.74
Oamaru ..	0.26	5	0.11	1.78
Queenstown ..	4.01	14	0.93	2.01
Clyde ..	1.25	9	0.25	0.94
Dunedin ..	2.14	11	0.78	2.99
Gore ..	2.90	14	0.70	2.05
Invercargill ..	2.98	22	0.34	3.41

Wool-control.—The question as to whether the New Zealand Wool Committee should be reappointed was referred to the Board of Agriculture. The opinion was expressed at the last meeting of the Board that the committee had done very good work in allocating the quantity of wool for the local sales in the various districts, and that it would be well that it should be continued. A resolution was passed that such a committee should be set up, consisting of two members to represent the sheepowners, to be appointed by the Sheepowners' Federation and the Defence Committee of the Farmers' Union in the Wellington Province; two to be appointed by the Wool-brokers' Association; and one farmer to be nominated by the Government.

Viticulture and Winemaking—Last season was a favourable one for all classes of grape-growing, and crops were above the average and comparatively free from disease. The vintage was estimated to produce 80,000 gallons of wine, representing a value of between £30,000 and £40,000. Table grapes grown under glass were valued at approximately £30,000. A good demand is reported for grafted vines of both wine and table varieties.

Australasian Association for the Advancement of Science.—The seventeenth meeting of the association will be held at Adelaide during the week commencing 25th instant, under the general presidency of Sir John Monash, Chairman of the State Electricity Commission of Victoria. The president of the Agriculture and Forestry Section is Dr. S. S. Cameron, Department of Agriculture, Melbourne; and Dr. S. Dodd, of Sydney University, presides over the Veterinary Science Section.

British Market for Peas and Beans.—The following advice was cabled by the High Commissioner, London, on 8th August: *Peas*—Demand for blue is limited to best. "A" grade Tasmanian, spot value about £20 per ton; July-August shipments, sellers £18, buyers £17 10s. c.i.f. Partridge No. 1 (New Zealand) offered August-September shipments at 72s. 6d. per 504 lb. c.i.f.; September-October shipment, 75s., but buyers' idea about 68s. to 70s.; spot new crop offered at 77s. 6d., old crop 70s. ex store. Japanese (green) offered at £19 10s. per ton ex store and for shipment c.i.f. For maple, English quiet at 56s. to 60s. for good quality; New Zealand best-quality spot, 60s. to 68s.; Tasmanian August-September shipments offered 72s. 6d. afloat, 75s. c.i.f.; ex-store value 75s. to 81s. *Beans*—Market quiet. English choice winter 49s. 6d., spring 58s. to 68s., per 532 lb. Chinese horse, July-September shipments sold at £10 10s. to £10 12s. 6d. per ton.

GRADINGS OF BUTTER AND CHEESE, 1923-24.

THE quantities of butter and cheese graded for export by the Dairy Division during the year ended 31st July, 1924, were as follows :—

Butter : Salted, 58,327 tons ; unsalted, 3,484 tons : total, 61,811 tons—a decrease of 8·9 per cent. compared with the figures for the preceding twelve months.

Cheese : White, 45,374 tons ; coloured, 28,573 tons : total, 73,947 tons—an increase of 20·7 per cent.

In terms of butterfat, the 1923-24 amounts for butter and cheese combined represent a net decrease of 0·17 per cent. compared with those for 1922-23.

PRECAUTIONS AGAINST FOOT-AND-MOUTH DISEASE.

UNDER an Order in Council dated 4th March last the importation of oats, barley, maize, hay, straw, and chaff from the United States of America was prohibited. Another Order, dated 30th July, has extended such prohibition as follows :—

(a.) Plants or portions of plants, all fruit and vegetables (other than dried, canned, pickled, pulped, or bottled fruit and vegetables), and all grain and farm-produce in addition to oats, barley, maize, hay, straw, and chaff, as already prohibited : Provided that in the case of all goods the importation of which is prohibited under this paragraph and not grown in any of the States of California, Oregon, and Washington, or directly handled or exposed within any of those States, otherwise than is necessary for through transportation to New Zealand, importation shall be permitted if the goods are accompanied by a certificate signed by a person appointed in that behalf by the Government of the State concerned, and countersigned by a responsible officer of the Federal Department of Agriculture certifying—(i) The name of the State in which grown ; (ii) that such State is, and has been for not less than twelve months, free from foot-and-mouth disease ; and (iii) that the goods under certification have not been directly handled or exposed within any of the States of California, Oregon, and Washington otherwise than is necessary for through transportation to New Zealand.

(b.) All hay, straw, chaff, or husks used as packing-material for goods of any kind, unless accompanied by a certificate signed and countersigned as aforesaid certifying such material to be the produce of a State other than the States of California, Oregon, and Washington, and that it has not been directly handled or exposed within any of those States otherwise than is necessary for through transportation to New Zealand.

IMPORTATION OF FERTILIZERS : JUNE QUARTER.

FOLLOWING are the importations of fertilizers into New Zealand for the quarter ended 30th June, 1924 : *Sulphate of Ammonia* : From Australia, 175 tons ; Belgium, 5 tons. *Nitrate of Soda* : Chile, 20 tons. *Gypsum* : Australia, 309 tons. *Basic Slag* : United Kingdom, 9,576 tons ; Belgium, 13,908 tons ; Netherlands, 201 tons ; France, 105 tons. *Bonedust* : India, 315 tons ; Australia, 527 tons. *Chardust* : Australia, 150 tons. *Guano and Rock Phosphate* : New Caledonia, 2,100 tons ; Nauru Island, 28,830 tons ; Makatea Island, 605 tons. *Kainit* : United Kingdom, 715 tons ; Belgium, 110 tons ; Germany, 295 tons ; France, 300 tons. *Muriate of Potash* : United Kingdom, 1 ton. *Sulphate of Potash* : United Kingdom, 95 tons ; Belgium, 25 tons ; Germany, 115 tons ; France, 25 tons. *Potash, other* : United Kingdom, 295 tons ; France, 150 tons ; Germany, 295 tons. *Sulphate of Iron* : Australia, 12 tons. *Miscellaneous* : United Kingdom, 2 tons ; Germany, 1 ton.

Noxious Weeds.—The Eketahuna County Council has declared wineberry to be a noxious weed within that county. Californian thistle has been declared by the Lake and Taiieri County Councils *not* to be a noxious weed within their respective districts ; ragwort has been similarly declared by Lake County.



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BUTTER-BOXES AND THEIR DESIGN.

PROPOSED METAL-BOUND WASTE-ELIMINATING TYPES.

A. R. ENTRICAN, Engineer in Forest Products, State Forest Service, Wellington.

I. INTRODUCTION.

THIS report presents the results of an investigation made by the State Forest Service, at the request of the Department of Agriculture, into the design and construction of butter-boxes suitable for the export butter trade. Design of these packages has been based upon recognized and proven principles of box-construction. Laboratory and service tests, however, form the only final and conclusive method of attacking the problem, and for this work a set of box-testing equipment is now being installed at the Auckland testing-station of the Forest Service. The results of these tests will form the subject of a special report.

Probably as much as 90 per cent. of the butter produced in New Zealand is shipped in white-pine boxes, the remaining 10 per cent. being carried in silver-beech and imported boxes. The virgin white-pine forests have been seriously depleted during the last twenty years, so much so that if a normal increase in consumption continues not more than fifteen years' supply remains. Even now manufacturers report difficulties in maintaining their supplies.

Complaints regarding excessive breakage of boxes have been received from time to time. This is due to bad nailing and to the unbalanced construction of the box.

Tentative specifications for two types of metal-bound butter-boxes are published in this report for trial and criticism. Both types are claimed to provide a stronger and cheaper package, and to consume 30 to 40 per cent. less timber than the existing standard export butter-box. Either sawn or veneered timber may be used. The nailless strap type (Fig. 1, page 147) is substantially the same as the existing type, except that thinner timber is used. The package is bound at the butter-factory with two flat metal straps, and box-factories will be able to change over to the manufacture of this type without any alteration to their equipment. The wire-bound veneer type uses still thinner timber than the nailless strap type, but requires special machinery for its manufacture. The box is cleated at the ends, and therefore takes up approximately 5 per cent. more shipping-space than the nailless strap type. It may, however, be sent from the box-manufacturer to the butter-factory in a folder-out condition (Fig. 2, page 151), thus offsetting to a slight extent any extra shipping-charges in the made-up form. The dairy industry of Victoria has used a similar type of box for some years, but has received many complaints regarding the rusting of staples on the inner surfaces of the box and the consequent staining of wrapping-paper and butter. This staining must be eliminated if the wire-bound veneer box is to be adopted for the New Zealand export trade; practical means of overcoming this trouble are now being investigated by the Forest Service.

Until the Victorian wire-bound box has been demonstrated in this country it is undesirable that the package be adopted for general use. Practically the same economy can be effected by the use of the metal-strapped box, without any expenditure on manufacturing equipment.

OBJECT AND SCOPE OF INVESTIGATION.

It is the main purpose of this investigation to provide a box which will render the greatest amount of serviceability for the smallest consumption of timber at the least possible cost of manufacture. The investigation is confined solely to the study of the mechanical and physical features of butter-box construction. Lack of mention of such factors as the use of substitute timbers and of shellacking and paraffining is due not to their unimportance, but to the fact that they are considered outside the scope of the present work. They will form the subject of a special report to be rendered at a later date.

The material for this study has been collected from reports issued by the Governments of butter-exporting countries, and by consultation with box-manufacturers, buttermakers, shipping agents, and officials of the Department of Agriculture.

The principles of box-construction have been established by the Madison Forest Products Laboratory of the United States Forest Service, and widely adopted by box-manufacturers and shippers throughout Canada and the United States. The use of metal straps was investigated by testing over two thousand nailed wooden boxes of various sizes and shapes, loaded with different contents varying in weight from 60 lb. to 800 lb., and bound with flat metal straps. Such investigations have been used as a basis for the present report.

GENERAL CONSIDERATIONS.

Essential features in a first-class butter-box are (1) good protection to the contents, (2) clean and attractive appearance, (3) ease of opening for inspection and grading, (4) balanced and economical construction, and (5) cheapness.

It is the primary purpose of a box to deliver its contents in the same condition as when first packed. The butter must reach its destination unstained, untainted, and dustless. The box should remain unbroken in any way. In a recent shipment of butter to London 14 per cent. of the boxes were reported to be broken. In a similar manner the Canadian market was unfavourably prejudiced last season by the delivery of a large number of broken packages. Preferably the box should be so constructed that any illegal opening for the substitution of inferior produce is easily detected.

The New Zealand box has for some considerable time been recognized by all dairying countries as one of the most attractive containers placed on the world's markets. Australia, Canada, America, France, Holland, Denmark, and Russia all pay tribute to the superiority of the New Zealand package. The English retailer favours it above all others for use in general delivery of goods from his store. Other things being equal, that butter which is contained in the finest package will sell the best, and the clean and attractive appearance of the New Zealand box has played a decided part in the development of the Dominion's export butter trade. With increasing supplies of foreign butters appearing on the English market it now becomes necessary as never before to maintain and increase the superiority of New Zealand's produce, not only by improving the quality of the products, but also by marketing them in as attractive a fashion as possible. This principle has been maintained as a primary consideration in the present study.

Approximately 5 per cent. of the boxes must be opened for grading purposes before shipment from New Zealand, and the ideal package should allow of easy opening for inspection and grading. With the grain of the ends and sides running parallel to the top and bottom surfaces, the knocking-off of tops often causes the box to fail by splitting of the ends and sides. The Forest Service is seeking to develop a box-opener which will eliminate these failures.

When all the elements in the construction of a box resist equally the destructive hazards of service the box is balanced in construction. A balanced box may yet be too strong, or excessively heavy, or even too weak, and the chief problem in box-design is to so detail the parts that balanced construction and proper strength are both obtained at a minimum cost. The failure of many New Zealand butter-boxes in spite of comparatively thick timber employed is an indication that the present design is lacking in these features.

2. THE NAILLESS METAL STRAPPED BOX.

Metal strappings applied to boxes improve the rigidity of the package, distribute shocks which otherwise are locally absorbed, and enable thinner timber to be used, thus making a safer and more economical container.

Metal strappings ordinarily encircle the small dimensions of the box, and act perpendicular to the grain in the sides, top, and bottom. Two types are in common use—nailed and nailless. The former is usually applied by nailing through flat metal straps at the extreme ends of the package; the latter relies upon the initial tension given to it when the ends are mechanically joined to keep it in position, ordinarily some distance from the ends of the box. Although the nailed type gives a slightly more rigid package, and offers some reinforcement to the box even after breakage of the strapping, the nailless type offers many advantages: (1.) It is cheap and easily to apply—approximately 1½d. per box. (2.) Removal and replacement at grading-stores is cheap and easy—approximately 1½d. per box. (3.) By use of a specially marked seal the illegal opening and closing of any package can be quickly detected. No substitution of inferior butter is possible. (4.) It does not detract from the appearance of the box.

ACTION OF METAL STRAPPING.

All metal strappings are of considerable value for holding the box-parts in place, even after some of the boards have pulled entirely loose at the joints. Nailless strappings applied some distance from the ends of the box help to distribute to the various parts of the box the shocks which are otherwise locally absorbed. This action relieves much of the direct pull on the nails in the ends, and also reduces materially the failures due to the sides, top, and bottom splitting or breaking across the grain.

The commonest failure in the existing box is the splitting of ends, which often allows the box to come in two. This tendency may be reduced by binding with two straps applied one-sixth of the length of the box from the ends.

The strapping must be drawn sufficiently tight to cut in the corners or edges of the box and to spring the sides, and should be maintained under considerable tension until the box has served the desired purpose. Strappings must be applied at right angles to the box, otherwise they will adjust themselves during transit and become quite loose. They should not be applied until immediately before the box is ready for shipment.

METAL STRAPS AND WIRES.

Both metal straps and wires are made in various sizes of both annealed and unannealed metal. Annealed metal has a much lower maximum tensile strength than unannealed strapping, stretches considerably more before failure or under a green load, has less holding-power at the seals ordinarily used to fasten the ends of the nailless strapping, and is more easily penetrated by nails.

Nailless strapping should be sufficiently hard to hold the seals effectively, and at the same time be sufficiently soft to permit ready application of the seals, and also to yield slightly and absorb shocks. Investigations have shown that strapping having a maximum tensile strength of approximately 84,000 lb. per square inch gives very satisfactory results. The seals used to hold the ends of nailless strapping should develop at least 75 per cent. of the strength of the strapping.

Where two flat metal straps are used as already recommended their total cross-sectional area in square inches may be calculated from the formula

$$\frac{\sqrt{2W}}{840}$$

where W = gross weight of box and contents
= approximate 65 lb.

The solution of this equation gives the nearest flat metal strap available as $\frac{3}{8}$ in. wide by 0.018 in. thick.

New Zealand State Forest Service tests show that the "Acme" flat metal strapping conforms to these specifications. Information is not yet available to allow any decision to be reached regarding the use of annealed wire bindings with a maximum tensile stress varying from 56,000 lb. to 76,000 lb. per square inch. The machines used for applying most types of nailless binding are very inexpensive, and in some cases are loaned free of charge when bindings are purchased from the owners of machines.

NAILING.

Metal bindings, however, do not assure in themselves a serviceable container. Nailing or other fastening at the joints is one of the most important factors in the construction of all boxes. Consequently the use of dense species such as silver-beech, &c., for ends, and the observance of other factors influencing the holding-power of nails, are of the utmost importance in both strapped and unstrapped boxes. Without sufficient nails or other fastenings at the joints the box lacks rigidity, and the straps hold the box-parts together merely as a bundle. A properly constructed unstrapped box, fastened with the right number of nails of the proper size and correctly spaced, is often stronger and gives better results than a box constructed with material of the same thickness and bound with metal straps but improperly nailed.

Cement-coated nails are used almost universally by box-manufacturers in Canada and the United States, as they have a much higher resistance to withdrawal than plain uncoated nails. The cement coating of the nail consists of various resinous gums mixed by a secret formula, and put on the nails by a baking process. Though the makers do not claim that the nails are absolutely rust-proof, they do claim that nails thus treated will resist the effects of moisture from 20 to 50 per cent. better than the uncoated wire nail. But it is when in use that the non-rusting quality is most evident. There is more coating on the nails than is actually necessary for holding-power. The heat caused by the friction in driving the nail softens the coating, and the surplus is forced towards the head, completely closing any opening: this prevents the admission of moisture between the wood and the nail. Under similar conditions of use the life of a cement-coated nail will be about twice as long as that of an uncoated one. They are claimed to require less force to drive, as the softened coating forms a lubricant. Any slight difficulties attached to their handling in the box-factory do not outweigh the advantages gained, and it is very desirable that the cement-coated nail should be adopted for boxing-work throughout New Zealand. Whereas a 2 in. cement-coated nail driven $1\frac{1}{8}$ in. into the side grain of a piece of American

pine required a force of 226 lb. to withdraw it, a common nail under the same conditions was withdrawn with a force of only 106 lb.

According to recognized practice, the existing $\frac{1}{2}$ in. white-pine box should be fastened with $1\frac{1}{2}$ in. cement-coated nails, by seven nails per end edge at the sides, six nails per end edge at the top and bottom, and two nails per side edge at the top and bottom. Where common nails are used an extra nail should be placed in each nailing-edge.

The proposed standard metal-strapped box will be fastened with $1\frac{1}{2}$ in. cement-coated nails, by seven nails per end edge at the sides, and by six nails per end edge at the top and bottom. The top and bottom boards are not the full width of the box, so that in applying the metal straps the sides are sprung inwards, thus tending to keep the straps in tension. Spacing-nails at the sides are therefore omitted. The overdriving of nails constitutes a serious source of weakness in boxes, and should be carefully guarded against. Nails should be driven until the top of the head is just flush with the surface of the material. Overdriving nails $\frac{1}{8}$ in., which is a common practice, probably reduces the strength of the box by at least 20 per cent.

As illustrative of the relation of the number of nails to amount of rough handling required to cause loss of contents, a number of boxes for two dozen No. 3 cans were tested by the Madison Forest Products Laboratory. The results showed that if a box with seven nails per edge was taken as a base (*i.e.*, 100 per cent.), then one with five nails was only 22 per cent. as strong, one with six nails only 75 per cent. as strong, but one with eight nails per edge was 45 per cent. stronger.

SAVING OF TIMBER.

As a result of the Madison tests already referred to, it has been established that the thickness of the sides, tops, and bottoms of well-balanced wooden boxes, possessing adequate strength and serviceability without metal strappings, may be reduced 20 to 40 per cent. when metal strappings are properly used, without any reduction in the strength and serviceability of the container.

The existing New Zealand butter-box may have the sides, top, and bottom reduced from $\frac{1}{2}$ in. thickness to $\frac{3}{8}$ in. thickness if one metal strap across the middle of the box is used, or to $\frac{5}{16}$ in. if two or more straps are employed. These reductions represent a saving in timber of approximately 30 per cent. and 18 per cent. respectively. Tests are required to show if still thinner material may be employed, especially in the case of beech, and if the same reductions in thickness are applicable where wire bindings are used. The weakest part of the box is the end, and, although $\frac{1}{2}$ in. material is permitted in the existing box, tests may indicate the advisability of increasing the thickness or of completely redesigning the end.

QUALITY AND FINISH OF TIMBER.

Either sawn or veneered material may be used, but, unless the box is constructed of dry timber, shrinkage is likely to occur and to reduce the circumference of the box to such an extent that the binding becomes quite loose—sometimes loose enough to permit it to

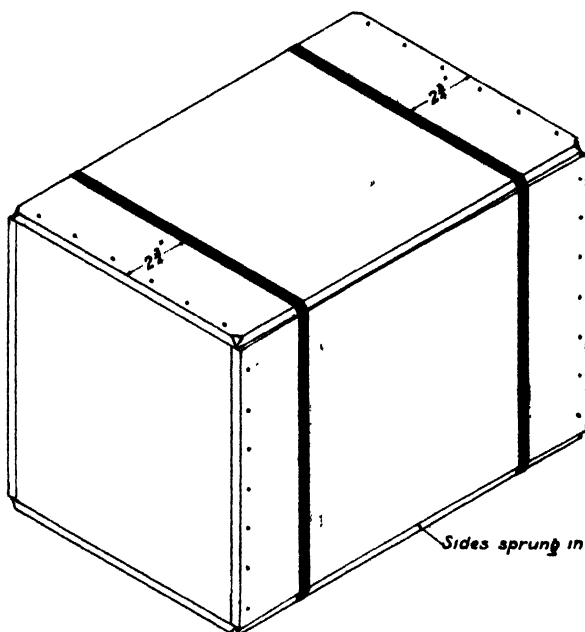


FIG. 1. PROPOSED STANDARD METAL-STRAPPED BUTTER-BOX.

slip off the end of the box. This looseness increases the tendency of the strapping to catch and tear when the box is slid down chutes or dragged across projecting objects, which constitute the most dangerous hazards to which the metal-bound butter-box is likely to be subjected.

The moisture content and change of moisture content in timber used in construction of the box also materially influence the failure of strappings. Timber which is abnormally wet or abnormally dry does not hold the nails so firmly as timber which is properly dried. The shrinkage and swelling of the timber cause a further loosening of the nails, and frequently cause the sides, top, and bottom to split and pull from the nails. The splitting of the boards and loosening of the nails permit greater stresses on the bindings, and thus increase the likelihood of strap failures. Timber should be used having a moisture content varying from 10 to 14 per cent., based on the oven-dry weight of the wood. Samples of wood taken from butter-boxes going into use have been found to contain 30 per cent. of moisture, based on the oven-dry weight of the wood.

The loss in strength of a box due to the use of improperly dried timber and to overdriving of nails may amount to more than 90 per cent. Such facts explain why a New Zealand visitor to Vancouver last year saw blocks of our butter being carried off the wharf on the bottom boards of the boxes—"all that was left of them."

Under the proposed specification fine band-sawn or veneered material will be allowed for sides, top, and bottom. This will make the box approximately $\frac{1}{4}$ d. to rd. cheaper than if planed. The ends should be smooth-planed as formerly.

ECONOMICS.

In addition to the indirect benefits attachable to the use of the metal strappings, such as reduced breakages and protection against substitution of inferior produce, there is a direct saving both in initial cost and in freight charges. As a basis of comparison it is assumed that timber is purchased from the sawmiller, worked up into boxes at a central plant, and distributed to butter-factories in an assembled form. Compared with the existing $\frac{1}{2}$ in. box the following savings should be effected by the use of the proposed metal-strapped package:—

Saving in initial cost of package	..	..	d.
Less cost of two straps	..	..	$4\frac{1}{2}$
			$1\frac{1}{2}$
Net saving in cost of package	..	..	3
Saving in freight, 6 per cent.	..	..	$3\frac{1}{2}$
Total saving per package	..	..	$6\frac{1}{2}$

If the box-manufacturer carried out the complete operation of saw-milling a further saving of 2d. to 3d. per box might be effected. Similarly, with a veneer plant a further saving of 3d. to 4d. might be made.

TENTATIVE SPECIFICATION FOR PROPOSED STANDARD METAL-STRAPPED BUTTER-BOX.

Section A : General.

(1.) Definition : The box as herein specified shall be known as the "Standard Metal-strapped Butter-box."

Section B : Timber.

(2.) Woods used : The following timbers shall be admitted under this specification : White-pine (*Podocarpus dactyloides*) ; silver-beech (*Nothofagus Menziesii*).

(3.) Material : (a.) The ends, sides, top, and bottom of the box shall be well manufactured, and shall be cut true to size. All defects in the timber which materially lessen the strength of the part, or expose contents to damage, or interfere with proper nailing, shall be prohibited. (b.) The wood shall be thoroughly seasoned, and shall have a moisture content of not less than 10 per cent. nor more than 15 per cent., based on the weight of the wood after oven-drying to a constant weight.

(4.) Dimensions : (a.) The inside dimensions of the box shall be $15\frac{1}{2}$ in. \times $10\frac{1}{2}$ in. \times $10\frac{1}{2}$ in. The width of sides, top, and bottom shall be $10\frac{1}{2}$ in. (The top and bottom do not cover completely the edges of the sides, which will be sprung inwards when the strapping is applied. This will assist to keep the strapping in tension.) (b.) The sides, top, and bottom shall be $\frac{3}{8}$ in. in thickness ; the ends shall be $\frac{1}{2}$ in. in thickness. (c.) The variation in thickness of the boards below the thickness specified shall be not more than $\frac{1}{32}$ in., and this variation below the specified thickness shall not extend over more than 10 per cent. of the face of that particular board.

(5.) Width of parts : (a.) The maximum number of pieces allowed in any side, end, top, and bottom shall be two, but in no case shall two-piece sides be fastened to two-piece ends. (b.) No piece less than 3 in. face-width at either end shall be allowed in any part. (c.) Matched and glued or lock-jointed boards shall be regarded as single pieces.

(6.) Jointing : (a.) All two-piece parts shall be match-jointed. (b.) Two-piece ends shall, in addition, be fastened with not less than two galvanized corrugated fasteners, 1 in. by $\frac{1}{2}$ in. (c.) All corners shall be chamfered.

(7.) Surfacing : (a.) The outside surfaces of the sides, top, and bottom may be fine hand-saw or veneered finish ; otherwise they shall be smooth-planed. (b.) The ends of boxes shall be veneered or smooth-planed finish.

(8.) Assembling : Joints in two-piece sides shall be so located that there is considerable distances between their respective planes.

Section C : Nailing.

(9.) Nailing schedule : (a.) $1\frac{1}{2}$ in. standard cement-coated box-nails shall be used. (b.) Nails shall be driven flush. (c.) The sides shall be attached to the end grain of the ends by not less than seven nails. The tops and bottoms shall be attached to the side grain of the ends by not less than six nails. (If other than cement-coated nails are used one more nail per edge must be driven.) (d.) No piece shall have less than two nails at each nailing end.

Section D : Metal Strapping.

(10.) Metal : (a.) Metal strapping shall be preferably of unannealed metal, and shall have a maximum tensile strength of approximately 84,000 lb. per square inch. (b.) The strapping for export boxes shall be galvanized or otherwise treated to protect against rust.

(11.) Fastenings : The ends of straps shall be fastened in such a manner that the joint shall have a breaking-strength of not less than 75 per cent. of the ultimate strength of the binding.

(12.) Size of strapping : The metal strapping shall be not less than $\frac{3}{8}$ in. in width by 0.018 in. in thickness.

(13.) Application : (a.) Not less than two strappings shall be used, placed round the smallest dimension of the box at right angles to the edges of the box. The distance of the outer strappings from the ends shall be approximately $2\frac{1}{2}$ in., and any others, if used, shall be spaced equally between the two outer straps. (b.) The strapping shall not be applied until immediately before shipment of the box, and shall be drawn sufficiently tight to sink well into the edges of the box and to spring the sides inwards.

3. THE WIRE-BOUND BOX.

Wire-bound boxes are especially suited for the carriage of contents which by virtue of their rigidity and other properties absorb considerable shock in themselves. Thicker timber is required for the carriage of other commodities, such as butter, which may be seriously injured by the puncturing of thin material by the corners of other boxes and projecting objects.

Fig. 2 (page 151) shows a "mat" for what is known as a "four-one" box, delivered by a stitching or fabricating machine, ready to be assembled with the end panels, or shipped in this form to the consumer. The cleats are held to the sheet material forming the sides, top, and bottom, by staples which pass over the wires, through the sheet material, and have their points firmly held in the cleats. Staples not driven into cleats are clinched in the inside surface of the sheet material. The box is assembled by folding the mat around the two end pieces, which are stapled or nailed on the inside surface of six of the cleats, the remaining cleat on each end being attached to the top only, as shown in Fig. 3. To close the box the binding-wires are twisted together near one edge of a side. The end joints of the cleats may be mortise-and-tenon, step, or plain mitre type. This four-one box has been used by the Victorian dairy industry for many years.

There are a number of similar boxes on the market, the chief variation being in the method of attaching the ends. One type, for example, attaches only two cleats at each end of the mat, the remaining cleats being stapled to the ends. In assembling the box the sides are stapled to the two cleats attached to the ends. This has the advantage of requiring only an outside stapling-machine, compared with an inside stapler required for the four-one type.

Wire-bound boxes are opened for grading and inspectional purposes by cutting the wires at their original fastenings. They are closed by twisting on a new piece of wire to one of the loose ends and twisting the two wires together again.

WIRES AND STAPLES.

Wire bindings are usually of annealed metal of a minimum size of No. 16 S.W.G.

The staples over all wires are spaced from $1\frac{3}{4}$ in. to $2\frac{3}{4}$ in. apart. It has been found that with $1\frac{3}{4}$ in. spacing the end binding-wires do not slip off the corners of the box so frequently as when the spacing is greater. Staples will not, as nails do in nailed strapping, hold for long the tension in the wire. Nevertheless the wires and staples should be so applied that when the mat is assembled around the ends the wires are in tension at the corners. If boxes are distributed in the mat each dairy factory will require to install a stapling-machine, at an approximate cost of £90 for an outside stapler or £300 for an inside stapler, depending upon the type of box used.

PROTECTION AGAINST RUST.

The greatest disadvantage attached to the use of the wire-bound package is the rusting of staples on the inside surfaces of the box, thus tending to stain both the parchment paper and the butter. This is a universal complaint against the Victorian box. The United States Bureau of Animal Industry, for the same reason, does not recommend the box. It should not be impossible, however, to eliminate this trouble by covering the exposed surfaces of the staples with a protective coating. The use of galvanized wire for the centre staples is not a complete solution of the problem, as the sheared-off ends of the staples expose unprotected metal when clinched over on the inner surface of the box.

Shipping containers are frequently subjected to adverse moisture conditions, and for that reason the wire should be treated to resist rust.

TIMBER.

Either veneer or sawn timber may be used, but, as in the case of the metal-strapped box, the wood must be thoroughly seasoned. The sheet material forming the sides, ends, top, and bottom should be a full $\frac{1}{4}$ in. in thickness, as the Victorian authorities have found that thinner material results in excessive breakages. The finish of the timber is the same as that used for the metal-strapped box.

ECONOMICS.

On the same basis as the metal-strapped box costs—that is, purchase of sawn timber from the miller, fabrication at a central plant, and distribution of boxes in the mat form—the following savings per box may be effected: On initial cost of package, $4\frac{1}{4}$ d.; on distribution freight charges, $\frac{1}{4}$ d.; on freight, 1d.; total saving, $6\frac{1}{4}$ d.

Further savings due to the operation of sawmill or veneer plant by the box-manufacturer will be approximately the same as for the metal-strapped box—that is, 2d. to 3d., and 3d. to 4d. respectively.

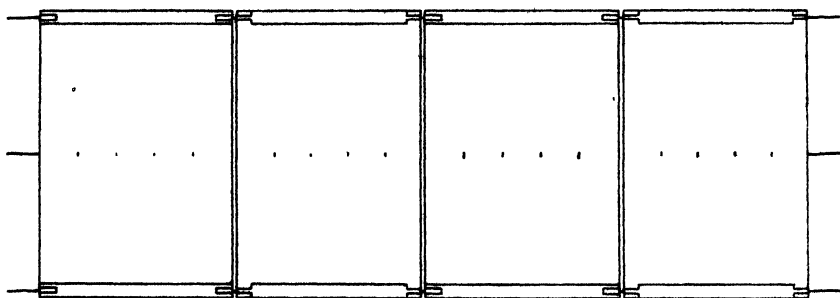


FIG. 2. "MAT" OF THE FOUR-ONE WIRE-BOUND VENEER BOX.

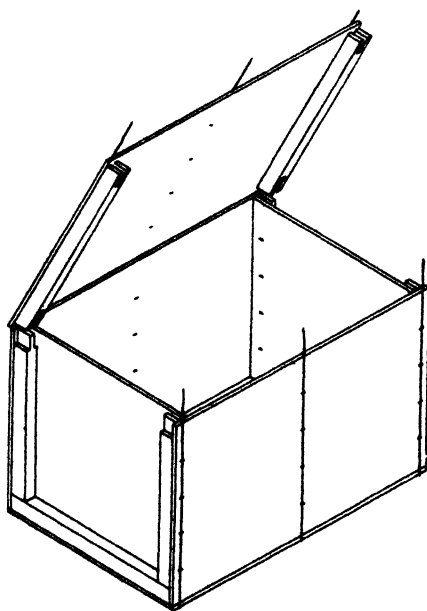


FIG. 3. THE FOUR-ONE BOX ASSEMBLED.

TENTATIVE SPECIFICATION FOR PROPOSED WIRE-BOUND BUTTER-BOX.

Section A : General.

(1.) Definition : The box as herein specified shall be known as the " Standard Wire-bound Butter-box."

(2.) Description : (a.) The boxes knocked down shall consist of separate sections forming top, sides, and bottom, connected only by continuous steel binding-wires, and of separate ends. (b.) Each of the separate sections forming the sides, top, and bottom shall consist of a thin board, wire and staples, and cleats where required.

Section B : Timber.

(3.) Woods used : The following timbers shall be admitted under this specification : White-pine (*Podocarpus darryldoides*) ; silver-beech (*Nothofagus Menziesii*).

(4.) Material : (a.) The thin boards shall be well manufactured, and shall be cut true to size. All defects in the timber which materially lessen the strength of the part, or expose contents to damage, or interfere with the proper stapling and assembly of the box, shall be eliminated. (b.) Each cleat shall be sound, and free from knots and from cross-grain which runs across it within a distance equal to one-half its length. (c.) The wood shall be thoroughly seasoned, and shall have a moisture content of not less than 10 per cent. and not more than 15 per cent., based on the weight of the wood after oven-drying to a constant weight.

(5.) Dimensions : (a.) The inside dimensions of the box shall be $15\frac{1}{2}$ in. \times $10\frac{1}{8}$ in. \times $10\frac{1}{8}$ in. (b.) Thin boards shall be $\frac{1}{2}$ in. in thickness. The variation in thickness of thin boards below the thickness specified shall be not more than $\frac{1}{32}$ in., and this variation below the specified thickness shall not extend over more than 10 per cent. of the face of that particular board. (c.) Only one-piece thin boards may be used. (d.) Cleats shall be not less than $\frac{3}{4}$ in. thick (parallel to the length of the box), and not less than $\frac{1}{4}$ in. in width.

(6.) Surfacing : (a.) The outside surfaces of the sides, top, and bottom may be fine band-saw or veneered finish ; otherwise they shall be smooth-planed. (b.) The outside surfaces of ends shall be of veneered or smooth-planed finish.

Section C : Wire and Staples.

(7.) Binding-wire : (a.) The binding-wire shall be of annealed metal, having a maximum tensile strength of approximately 66,000 lb. per square inch. (b.) Binding-wires shall be not less than No. 16 S.W.G.

(8.) Staples : (a.) The staples on end wires shall be not less than No. 16 S.W.G. by $1\frac{1}{2}$ in. long. (b.) The staples on the intermediate wire shall be not less than No. 18 S.W.G. by $\frac{1}{16}$ in. long.

(9.) Protection against rust : (a.) Wires and staples used for export boxes shall be treated to protect them against rust. (b.) Before any staples for use on the inside surfaces of the box are approved they shall be required to pass a six months' rust-resistance test under actual service conditions.

Section D : Fabrication of "Mat."

(10.) Driving of staples : (a.) The staples on end wires shall be driven home astride the binding-wires, through the thin boards into the cleats, and anchored in the cleats. (b.) The staples on the intermediate wires shall be driven astride the binding-wires, through the thin boards, and firmly clinched.

(11.) Spacing of staples : (a.) The space between staples shall be the average distance between centres of staples astride each binding-wire in each section, and this space shall be not more than $2\frac{1}{2}$ in. (b.) The staples nearest the corners shall be not more than $1\frac{1}{2}$ in. from the corner to which they are adjacent.

(12.) Spacing of sections : The separate sections, forming the sides, top, and bottom, shall be separated such a distance from each other that at each corner one section shall overlap its adjacent section at right angles, and the wires shall be in tension when the sections are folded to give a square tight corner.

Section E : Assembly.

(13.) Fastening of ends : (a.) Each end of the box shall be securely fastened to the folded mat by staples or cement-coated nails driven into the cleats. (b.) The space between staples or nails shall be not less than $1\frac{1}{2}$ in., and there shall be a staple or nail driven $1\frac{1}{2}$ in. from the ends of each side cleat. (c.) The staples shall be not less than No. 16 S.W.G. by $\frac{1}{16}$ in. long. The cement-coated nails shall be not less than 1 in.

(14.) Fastening cover : The cover shall be closed tightly, and the ends of each binding-wire twisted tightly together. The twisted portion of each wire shall be not less than $\frac{1}{2}$ in. long. The rough ends of the wires shall be removed, and the twisted portion driven flat against the sides parallel with the binding-wire.

4. CONCLUSION.

Many profitable fields of investigation have been suggested as a result of the foregoing study. The possibilities attached to the wire-binding of boxes and the balancing of wooden-box construction are problems of immediate importance. The nail-holding power of the native woods should be determined, so that the timbers may be properly classified and nailing schedules for them developed. This work will be undertaken as funds and personnel become available.

This report has been rendered possible by the courtesy of the United States Forest Products Laboratory in making available the results of its very extensive experiments on box-construction. The sincere appreciation of all box consumers and manufacturers is due to the staff of that institution, and especially to Mr. C. A. Plaskett, Engineer in Forest Products, who was in charge of the investigations referred to in this report.

FARMERS' FIELD COMPETITIONS.

TARANAKI, WANGANUI, FEILDING, AND RONGOTEA
DISTRICTS, SEASON 1923-24.

J. W. DEEM, Instructor in Agriculture.

FARMERS' field competitions in the Taranaki, Wanganui, Feilding, and Rongotea districts were continued in the 1923-24 season on the same lines as in past years, thirteen centres holding competitions, against fourteen in the previous season. It was thought that the dry period in the late spring of 1923 would have a detrimental effect on the weight of the root crops, but the favourable autumn appears to have compensated for this to a great extent. One hundred and forty-eight mangold crops were judged, against 119 last year. Carrot crops also show an increase from 64 to 79. Swedes and lucerne show a slight decrease, the figures being—lucerne, 61 (71); swedes, 30 (63). Soft turnips were 20—the same number as last year. The total of crops judged was 338, compared with 337 in the previous year.

The crops were judged by Instructors Glasson, Smith, McCulloch, and the writer. Mr. McCulloch has taken over the Feilding and Rongotea districts, and shared in the judging there during the past season. Smaller competitions were also held in some districts, and awards made by local judges. As in previous years, farmers turned out in fairly large numbers to see the crops judged and discuss related farming matters. In a few centres a number of senior schoolboys were taken round, and received an excellent optical lesson in how to care for a good crop.

The usual display from the competitions was staged at the Hawera Winter Show, the exhibits being set up under cards indicating the districts they came from and giving full particulars of cultural methods.

It was shown last year that in localities where the competitions have been in existence longest the average crop is gradually increasing,

and this has been further emphasized this year. The general care and careful cultivation given are very gratifying to all interested, and to the judges in particular, it now being quite rare to see a neglected crop.

MANGOLDS.

Taking the various districts where competitions are held, the mangold has pride of place, the 148 crops judged this year giving an average of 65 tons 2 cwt., against an average of 53 tons 12 cwt. last year, or an increase per acre of 11½ tons.

The following table gives the averages for the Taranaki, Wanganui, Feilding, and Rongotea districts :—

District.	1920-21.	1921-22.	1922-23.	1923-24.	Four Years' Average.
	Tons cwt.	Tons cwt.	Tons cwt.	Tons cwt.	Tons cwt.
Taranaki	51 9	56 18	54 19	64 9	56 18½
Wanganui	44 1	56 18	65 19	73 13	60 2½
Feilding	33 19	46 10	42 15	62 1	46 6½
Rongotea* .. ..	..	..	57 2	66 17	61 19½

* Two years only.

The various championships in 1923-24 were won as follows :—

Taranaki: Mr. Fred. Hoskin, Matapu, Prizewinner Yellow Globe, 96 tons 19 cwt. Mr. C. Willis, last year's winner, did not compete this year.

Wanganui: Mr. H. Birch, Maxwelltown, Prizewinner, 116 tons 15 cwt. This is Mr. Birch's third win in succession.

Feilding: Mr. H. V. Benge, Feilding, White Sugar, 93 tons 4 cwt.

Rongotea: Mr. E. Nix, Kopane, Prizewinner, 110 tons 3 cwt.

These crops also win the Sutton Cup for their respective districts. As Mr. Birch has gained first place three years in succession he now wins the cup right out, and the writer takes this opportunity of publicly congratulating him on his very fine performance. His crops for the three years were: 1922, 88 tons; 1923, 93 tons 5 cwt.; 1924, 116 tons 15 cwt.—an average for the three years of 99 tons 6½ cwt. Messrs. Sutton and Sons, through their New Zealand agents, Messrs. J. G. Ward and Co., recognizing the tangible results that are being obtained from these competitions, have agreed to give another cup to replace the one won by Mr. Birch, and have also promised a cup next season for north Taranaki if competitions are started there. This makes a total of six cups for the districts in question since 1922, and as the firm makes no restriction as to whose seed is used their assistance is very highly appreciated.

Varieties.—An analysis of the crops grown in the competitions shows that Prizewinner won twelve out of thirteen competitions, the other being won by White Sugar. Then, if the ten heaviest crops in all the competitions are taken, it is found that seven were Prizewinner, two a mixture of Prizewinner and White Sugar, and the other White Sugar. Prizewinner is the variety most commonly grown in these districts, and it seems to do wonderfully well in all classes of soil; at the same time, White Sugar and Jersey Queen are running it very close in some

localities. White Sugar has the great advantage of being a great germinator and a wonderfully quick grower in the early stages. Long Red continues as the poorest all-round mangold grown in these districts, but Red Intermediate is promising better.

The 148 crops in the competitions this year give the following figures: Prizewinner, 89 crops, average per acre 68 tons 8 cwt.; mixture of Prizewinner and White Sugar, 15 crops, average 68½ tons; mixture of Prizewinner and Jersey Queen, 8 crops, average 64 tons 6 cwt.; White Sugar, 7 crops, average 69 tons 1 cwt.; Jersey Queen, 9 crops, average 57 tons 13 cwt.; Long Red, 14 crops, average 54½ tons; Golden Tankard, 3 crops, average 52 tons 13 cwt.; mixed varieties, 3 crops, average 61 tons 17 cwt. per acre. In some parts there was a considerable amount of heart-rot this year, and it was mostly confined to Prizewinner Yellow Globe, White Sugar being practically free even in fields where it was grown mixed with affected Yellow Globes.

Manures.—The competitions again emphasize the fact that most of the manures supplied for growing mangolds will give good results, provided they are used liberally and assisted by good cultivation both before and after the crop is sown. The following are the manures used on the winning crop in each district: Maxwelltown (yield, 116 tons 5 cwt.), superphosphate and bone, equal parts, 8 cwt. per acre, plus 2 cwt. salt and ½ cwt. nitrate of soda applied at thinning-time; Rongotea (110 tons 3 cwt.), 2½ cwt. mangold-manure; Matapu (96 tons 19 cwt.), mangold-manure, 4 cwt.; Feilding (93 tons 4 cwt.), mangold-manure, 5 cwt., plus salt 3 cwt.; Otakeho (90 tons 18 cwt.), super 3 parts, bone 1 part, Ephos 1 part, 6 cwt.; Manaia (87 tons 11 cwt.), super and bone, 4 cwt.; Mangatoki (84 tons 10 cwt.), bone, super, and blood-and-bone, equal parts, 5 cwt.; Toko (78 tons 12 cwt.), super, bone, and slag, equal parts, 6 cwt.; Brunswick (78 tons 6 cwt.), mangold-manure, 5 cwt.; Auroa (72 tons 11 cwt.), half basic super, half kainit, 5 cwt. per acre. These particulars are given as a guide to the respective districts. It is obvious that it would not be fair to compare Toko, for instance, with Feilding, as the growing of a 78-ton crop at Toko is a better performance than a 93-ton crop at Feilding when the differences in land and climate are taken into consideration.

Date of Sowing, Seed per Acre, and Width of Drills.—These, again, vary considerably, but the average of the good crops seems to be 6 lb. of seed, and drills 24 in. to 26 in. apart. There is no doubt that very heavy crops can be grown in 21 in. drills, but this entails a lot of hand-work. The competitions have proved very definitely that the Globe varieties can be grown in much closer drills than Intermediate or Long varieties such as Sugar, Jersey Queen, or Long Red. The latter type of mangold grows a much heavier top, and requires more room to admit sufficient light to the roots. The dates of sowing also show a wide range, but it is safe to say that any time between 15th October and 15th November is quite suitable for most of the localities. The warmer the situation the earlier can the crop be sown, but when the situation is 500 ft. or more above sea-level the end of October is early enough. In thirty-three placed crops sixteen were sown between 1st and 15th November, with an average yield of 80 tons 11 cwt., and seventeen crops between 1st and 30th October, with an average yield

of 77 tons per acre. The following table, comprising some of the winning crops, is of interest :—

Locality.	Yield of Crop.		Date sown.	Seed per Acre.		Width of Drills.	Average Yield for Competition.	
	Tons	cwt.			lb.		Tons	cwt.
Maxwelltown ..	116	15	Oct. 1		10	22	73	13
Rongotea ..	110	3	Nov. 14		8	24	66	17
Matapu ..	96	19	Oct. 20		5	21	74	17
Feilding ..	93	4	Nov. 5		4	30	67	1
Otakeho ..	90	18	Nov. 15		7	21	68	5
Manaia ..	87	11	Oct. 28		6	28	64	0
Mangatoki ..	84	10	Nov. 7		6	21	64	13
Toko ..	78	12	Oct. 26		6	26	65	9
Kiwitea ..	78	11	Nov. 4		3	26	57	1
Brunswick ..	76	6	Nov. 4		4	28	58	1
Auroa ..	72	11	Nov. 2		8	21	56	2

SWEDES.

The swede crops in general were very poor. In some districts there were large entries for the competitions, but the majority of the crops rotted before judging-time. The thirty crops judged gave an average of 32 tons 19 cwt. per acre, against 34 tons 7 cwt. last year. No varieties appear to stand out very prominently. The winning variety and respective yield per acre in each district were as follows : Manaia, Magnum Bonum, 50 tons ; Otakeho, Grandmaster, 46 tons 18 cwt. ; Toko, Superlative, 30 tons 17 cwt. ; Kiwitea, Webb's Empire, 55 tons 16 cwt. ; Apiti, Vilmorin's Purple-top, 57 tons 7 cwt. ; Feilding, Magnum Bonum, 30 tons 11 cwt. ; Matapu, Grandmaster, 36 tons 16 cwt. ; Mangatoki, Magnum Bonum, 37 tons 15 cwt.

All sorts of fertilizers have been tried, but they do not appear to have any effect on the amount of rot. As a rule, the later the crop was sown the freer it has been from rot.

CARROTS.

This root continues to come more and more into favour, both in cattle and sheep districts, no doubt owing to its freedom from disease and excellent feeding-qualities. Matchless White and White Belgian are most favoured for cattle, but some very fine crops of Sinclair's Champion and Barriball are also seen. For sheep-feeding Guérande gives best results, as the roots do not require thinning or digging. The carrot crop as a whole this season promised to be very good, but a severe storm accompanied by salt spray in March cut the tops about badly, particularly in exposed positions near the coast, where they were completely blackened, with the result that root-development practically stopped, the plants using their energy to send out new leaves. Where the plants had not been too badly knocked about they were successful in growing new tops, but in other cases the crop rotted badly. The average yield for the seventy-nine crops judged this year was 38 tons

10 cwt., against 41 tons 4 cwt. last year, the district which suffered badly from the salt spray being responsible for a large reduction in the average. For example, the average for Otakeho this year was only 27 tons 4 cwt., against 40 tons 18 cwt. last year, and the crops appeared* to have been better cared for. The heaviest individual crop this year was 67 tons 4 cwt., against 62 tons 3 cwt. last year.

Analysing this year's competitions it is found that forty-four Matchless White crops average 37 tons 4 cwt. per acre; twelve White Belgian, 39 tons 18 cwt.; ten Sinclair's Champion, 31 tons 10 cwt.; seven mixed crops, 31 tons 11 cwt.; two Barriball, 50 tons 16 cwt.; two Magnum Bonum, 26 tons 6 cwt.; two Yellow Intermediate, 23 tons 1 cwt. The following table gives the weight of winning crops, date of sowing, seed per acre, and width of drills in a number of the competitions, also the average of the respective competitions:—

Locality.	Yield of Crop.		Date sown.	Seed per Acre.		Width of Drills.	Average Yield for Competition.	
	Tons	cwt.		lb.	Inches.		Tons	cwt.
Maxwelltown ..	67	4	Nov. 3	1	27		47	8
Matapu ..	57	7	Oct. 14	1	14		38	14
Manaia ..	51	13	Oct. 19	1½	15		35	14
Brunswick ..	51	8	Nov. 1	1	14		45	19
Toko ..	50	18	Sept. 25	4	14		36	7
Kiwitea ..	47	17	Oct. 28	½	28		43	9
Otakeho ..	41	18	Oct. 25	1½	14		27	4
Feilding ..	41	16	Nov. 10	1	30		43	9
Mangatoki ..	38	13	Nov. 7	1	14		36	0
Auroa ..	34	19	Nov. 3	1	14		31	6

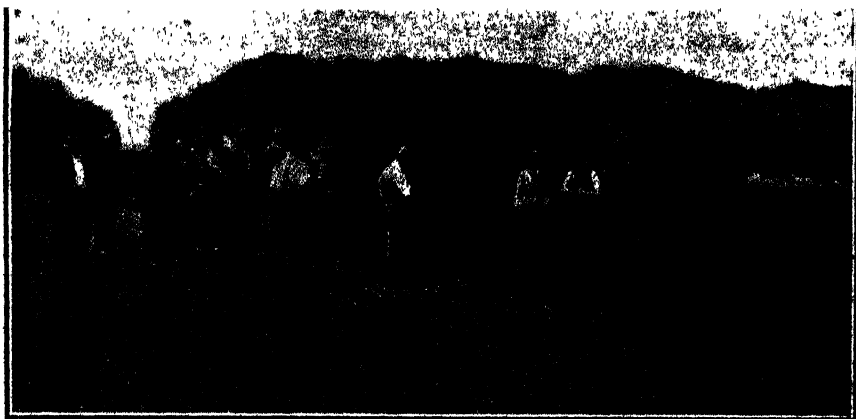
Manures.—The following was the manure used for the winning crop of carrots in each locality: Maxwelltown, bonedust and super, equal parts, 4 cwt. per acre; Matapu, mangold-manure, 3 cwt.; Manaia, carrots followed potatoes, grown in pig-paddock; Brunswick, 1 part bonedust, 3 parts super, 5 cwt.; Toko, 4 cwt. super, 2½ cwt. slag, 2 cwt. bonedust, 1 cwt. sulphate of potash; Kiwitea, 2 cwt. super, 2 cwt. Ephos; Otakeho, 3 parts super, 1 part bonemeal, 1 part Ephos, 3 cwt.; Feilding, blood-and-bone, 5 cwt.; Mangatoki, 2 cwt. super, 2 cwt. bone, ½ cwt. kainit; Auroa, mangold and carrot manure, 4 cwt. per acre.

Feeding-values.—The remark is frequently heard, particularly when judging root crops, that the red carrot has a very much better feeding-value than the white. The following analyses, made recently by the Department's Chemist, of carrots grown on the Moumahaki Experimental and Stratford Demonstration Farms, show that there is not much difference, and that very-deep-red carrots like Magnum Bonum and Guerande are no higher in feeding-value than Matchless White or White Belgian:—

	Average Weight of Crop.		Average Dry Matter.	
	Tons	cwt.	Per Cent.	
Sinclair's Champion	27 5
Barriball	34 15
Matchless White	36 15
Guerande	31 5
Magnum Bonum	31 0
White Belgian	37 0
				10·41
				10·22
				9·47
				9·39
				9·35
				9·34

LUCERNE.

The followers of the lucerne competitions this year were very keen, as at judging-time—the end of January—most pastures were burnt up, while the lucerne stood out fresh and green. Some very fine stands were examined, and as feeding-out was prevalent the sixty-one crops judged provided an opportunity of inspection at all stages of growth. Three classes were again provided—namely, stands under twelve months, stands over twelve months and under two years, and mature stands. In the Rongotea district the winning mature stand gained 39 points out of a possible 40. This crop was broadcast on 16th December, 1920, with seed at 23 lb. per acre, and was manured with 2 cwt. of basic super per acre in 1922. The winner in the class under two years gained 36 points. This stand was sown broadcast on 26th October, 1923, at the rate of 12 lb. of seed per acre, and was manured with 1 cwt. of nitrate of soda per acre. Last year the same stand secured 31 points. At Otakeho the winning mature-class crop had been sown through every coulter of the drill with 20 lb. of seed per acre, and manured with 2 cwt. of super and 3 cwt. basic slag; it had also received $\frac{1}{2}$ ton of lime and 2 cwt. of inoculated soil. This crop gained 39 points out of 40, as compared with only 29 points last year. The class under two years was won with 34 points by a stand sown through every coulter of the drill at 15 lb. of seed per acre, and manured with 3 cwt. super and 7 cwt. lime. The winning first-year crop, sown on 6th December last, with 20 lb. of seed through every coulter, and manured with 2 cwt. super and 1 ton lime per acre, gained 36 points. At Tokaora the mature-class crop, sown through every coulter of the drill at 20 lb. per acre, and manured with 4 cwt. basic slag and 10 cwt. lime, gained 39 points. The two-year-class crop, sown on 24th December, 1922, with 15 lb. seed cross-drilled through every coulter, and manured with basic super $2\frac{1}{2}$ cwt. and carbonate of lime 9 cwt. in 1921, and burnt lime 10 cwt. in 1922, gained 33 points. The under-twelve-months crop, sown 30th October, with 20 lb. seed through every coulter, and manured with 4 cwt. basic slag and 10 cwt. lime, gained 39 points.



JUDGING A LUCERNE CROP IN THE SOUTH TARANAKI COMPETITIONS.

PLANT-SELECTION AND SEED-PRODUCTION.

WORK AT THE MOA SEED FARM.

(Concluded.)

J. W. HADFIELD, Manager, Moa Seed Farm, Dumbarton, Central Otago.

II. SEED-PRODUCTION—*continued.*

TRANSPLANTING.

In an average winter onions planted in the autumn will give a greater yield than spring-planted bulbs, but here we find the risk rather too great, as many of the bulbs fail to grow. Autumn-planted bulbs root during winter, and throw up vigorous seed-stalks in the spring. If the reverse takes place, and the bulbs shoot before they root, it is an almost certain indication of a poor seed-crop. The ideal bulb for seed purposes is a hard, well-matured bulb, not less than 1½ in. in diameter. Our conditions are such that we find the greatest difficulty in ripening off bulbs before wet weather sets in during March, and we are now endeavouring to overcome this difficulty by growing our bulbs farther into the Central Otago district, near Alexandra, where perfect bulbs for our purpose can be raised. The bulbs are set out 9 in. to 12 in. apart, in drills 3 ft. apart, and covered with about 3 in. of soil. For a few weeks they may be cultivated, but when the seed-stalks develop the danger of damaging these with the cultivator is too great, and it is also inadvisable to disturb the roots, which spread across from one drill to the next.

Parsnips, carrots, mangolds, and beets are transplanted in the order given. Parsnips and carrots are most rapidly transplanted by using a hillside plough, and pushing the roots well down to the crown in the soft, freshly turned soil of every fourth furrow. One man ploughing, a second carting, and a third bagging the roots in cement bags, together with five men planting, forms a very effective working-gang, which is capable of planting over an acre in an eight-hour day. This method is quite effective when the roots can be irrigated soon after planting, or where there is reasonable chance of rain washing the soil well round them. It is not effective, and, in fact, no system of planting is easy in soil that is too heavy or too wet to crumble when worked. The main care in planting should be to see that the roots are planted firmly; and no doubt the most effective way, though slower and very arduous, is to open out drills, drawing the soil to the roots with a short-handled hoe, and trampling the soil firm while planting the next root. The final covering and levelling can then be done with a cultivator. The drills are opened up 4 ft. apart, and the roots spaced 18 in. to 24 in., the depth of the drill being dependent on the variety being planted.

Mangolds and beet are planted in the manner just described, but the drills have to be very deep for long red mangolds. As it is distinctly advantageous to cover these up to the crown if possible, and as it is impossible to open a drill to this depth, it is necessary to fill the soil round the roots, after which cultivation is very difficult and weeds get a good hold.

In all cases the cultivator should be worked as much as possible between the drills. Parsnip is the cleanest crop, as it grows so vigorously as to completely smother any weeds that develop late in the season. If time is available, hoeing between the roots in the early stages of growth is very beneficial.

Light silty soil gives very good results with carrot, parsnip, and onion, but heavier and damper soils give the heaviest yields of mangold and beet seed. Our experience would indicate this to be particularly the case with beet-root.

Onions are liable to many diseases, but carrots, mangolds, and parsnips are particularly free. The later seed-heads or umbels of the carrot become covered with green aphid, but this trouble is rapidly disappearing, and although last season was one of the most favourable we have experienced for aphid development, they were almost absent from the carrot crop. This we attribute almost entirely to the work of ladybirds, which are present in large numbers, and are annually increasing.

HARVESTING THE SEED.

The parsnip crop is the first to ripen, and the first picking is made about the New Year. The central umbels ripen first, and, although the first picking is a very light one, the seed has the best appearance, though its actual bushel-weight is less than that of the smaller seed harvested later. Seed is ready for harvesting when the stalk and seeds show a tinge of brown, but, as this indication may not be present, it is a very difficult matter to clearly describe the stage when ripe enough to cut. A ripe head when shaken gives a sharp rattle, whereas a green head emits a much duller sound. Parsnip-seed is produced in pairs, and if when these are pinched between the fingers they separate readily it is a sure indication that the head is ripe. Given a little instruction and a few hours' practice, a picker is able to select, without mistake, any heads which are fit for the harvest. The heads are cut off with a sharp pocket-knife, and pushed into a sack suspended from around the shoulders. As these fill they are emptied on to tarpaulins and carted to the drying-shed, where they are spread in the sun during the day and taken under cover at night.

During hot weather if the seed-heads are turned frequently they are ready for a first flailing after two days in the sun. The seed is sieved into drying-trays, 6 ft. by 3 ft., and 5 in. deep. These are made of light Oregon timber with hessian bottoms, and will conveniently hold 56 lb., or one sack of seed. These trays are set out on a platform in the sun for several days, and the seed stirred at frequent intervals. When thoroughly dry the seed is tipped out on to the floor, where drying is completed and the various threshings mixed before being bagged.

After the first flailing a large amount of seed still remains on the heads. These are spread out for a second drying, and after a second flailing what little seed remains on the heads is of small value.

The second and third cuts of parsnip-seed from the paddock are the heaviest, and the third cut will include almost everything of any consequence. If, however, the crop ripens unevenly, and there still remains seed on the plants sufficient to warrant the expense, the plants

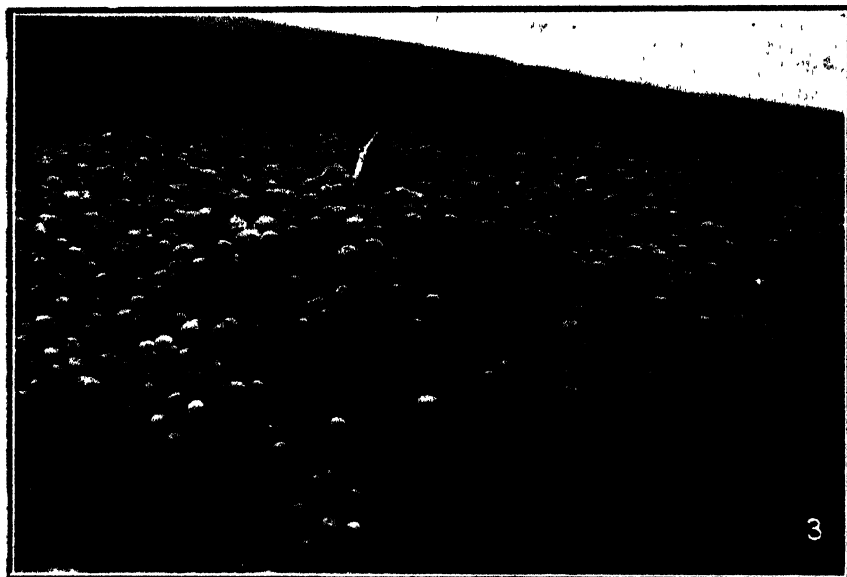


FIG. 3 CARROT-SEED CROP IN FULL FLOWER AT THE MOA FARM

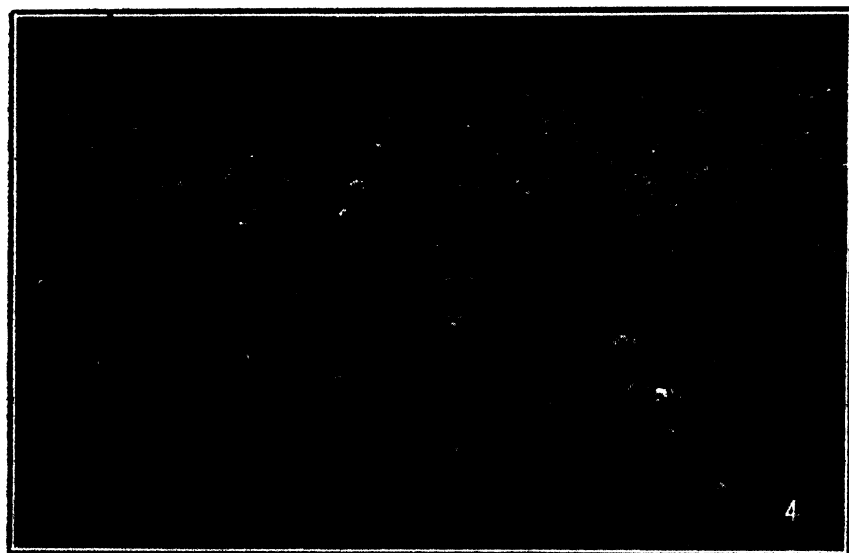


FIG. 4. LETTUCE CROP IN HEART.

The hearts have to be slit open to allow the seed-stalks to rise.

may be pulled up by the roots and stooked, placing about twenty plants to the stook, these being held together with binder-twine or flax. After a few days in the sun these stooks are pushed over on to a tarpaulin, when a few strokes from the flail will thresh out any seed, and this can be collected from the tarpaulin beneath.

Parsnip will be mostly harvested by the end of January, about which time the carrot crop begins to ripen. The central umbel of the carrot ripens much earlier than the rest of the seed, a light-brown colour indicating that it is sufficiently mature for harvesting. If left till the other umbels are ripe, which is towards the latter part of February, the former seed is very largely wasted, and if we have the labour available we go through the crop and make a first cut by hand. This is dried similarly to parsnip, but when dry we do not flail it, the heads being bagged and reserved for threshing in the mill when the remainder of the crop goes through.

Carrot-seed does not shed so readily as parsnip, and when the majority of the heads are brown the stalks are cut with scateurs and laid in bundles or sheaves, and tied up with flax. If the bundles are neatly made, and of even length, they can be stooked in the paddock; no ordinary wind will shift them, and very little seed is shed. The stooks remain in the paddock until thoroughly dry, when they are carted to the mill and threshed.

Mangold and beet ripen about the same time as carrot, but generally before the main cut of the latter takes place. The seed in both cases is shed rather easily when ripe, and birds soon cause further loss. For these reasons it is sometimes necessary to make a preliminary cut of this seed also. The stalks are cut and placed in bundles, and may be allowed to dry in the paddock for a day or so if the weather is settled. It is important that this seed shall not get wet, as it is not only difficult to dry out again but the seed is discoloured, and there is a loss of germination. We do not tie up the bundles. They are carted to a central position, where they are placed upright on old canvas or sacks, making stooks half a chain or so in length. In the event of rain, they are covered with tarpaulins, and are generally turned and restooked once during drying. The drying-process is rapid, and within a week they should be fit to be built into small stacks 4 ft. wide and about 6 ft. high. Drying and ripening continues in these stacks, and by the time the main crop of carrot is ready for threshing out of the paddock they can also be carted and threshed.

The best beet and mangold seed is saved by pulling up the entire plant, including the root, and hanging it up to dry and ripen. This method, however, is only practicable in raising stock seed where the additional expense is warranted.

Onions require two cuts as a rule. Here, again, the best seed is saved by cutting the stalks near the ground and hanging them up to dry. In this instance, however, careful attention must be paid to ventilation, otherwise heads which are touching become mouldy long before they become dry. Heads are ready for cutting when the seed "pods" or heads commence to open, showing the black seed within. The heads are cut off with very little stalk attached, and are spread out to dry. Drying is a very slow process, and the heads must be

constantly turned to avoid mould. We have never grown sufficient onion-seed to warrant threshing in a mill, but this is the usual practice in California.

The onion is one of the last crops to ripen, generally about the second week in March, and we have always experienced great difficulty in drying and threshing. It is also a most erratic yielder, and we are not at all certain that we can deal with this seed commercially. Factors altogether outside of our control contribute to this uncertainty. Sun-burn, hot winds, and cold winds during blossoming-time all detrimentally affect the setting and filling of seed; besides, there are probably a score of other diseases and tribulations to which the onion crop is liable.



FIG. 5. ROGUING ALDERMAN PEAS.

RESIDUES.

It is said that growing onion-seed improves the land. Whether this is true or not, we certainly do not find the other roots have any beneficial effect, even though the cultivation is necessarily very deep. Carrots and parsnips are all absorbed into the stem. On wet soil, however, onions will throw up a second and even a third crop of seed-heads in successive years, but the stand is very thin and never warrants the saving. Mangold particularly, and beet to some extent, can be used for pig and rough cattle feed after a crop of seed has been removed. They are somewhat hard and woody, but we invariably use them till the autumn, when more palatable and nutritious roots are available.

The stalks of carrots and parsnips are difficult to dispose of. We find the most effective way is to disk and cross-disk the land, and leave the stalks to lie till winter ploughing.

THRESHING.

We have in use on the farm a No. 2 Keystone peg-drum mill, driven by a 6-horse-power oil-engine. Considering the great variety of uses to which the mill is put we get remarkably good results from this one machine. Three or four men are required to thresh and handle root-seeds, but five to six are required for cereals and peas. We have put through 33 bushels of peas, 48 bushels of wheat, and 84 bushels of oats each in one hour, but the threshing of root-seeds is always a very slow process.

DRESSING.

We do not at present make any attempt on the farm to dress seed for market, with the exception of cereals, sweet-pea, and onion seed. Parsnip-seed is put over a fan mill with the object of removing the stalks. Mangold-seed and beet-seed may require further drying before being bagged, and they also are passed over a fan mill to remove sticks, small seed-clusters, and dust.

Onion-seed requires special treatment. It is dressed through a fan mill, but this does not remove all the impurities, nor does it remove light seed which contains no kernel. After a preliminary dressing the seed is poured slowly into water and thoroughly stirred. Chaff and light seeds float to the surface, where they can be skimmed off. The good seed sinks to the bottom, and is poured over a fine sieve, and from thence to drying-trays. The seed should not be under water for more than a few minutes, and half an hour would probably constitute the limit beyond which the seed is liable to suffer in germinating-power. Rapid drying is also essential, and for this reason it is advisable to perform the operation in the forenoon, allowing the hot afternoon sun for complete drying before night. The seed apparently can stand very low temperatures, and we have had seed, which we were unable to dry, frozen overnight, but which still showed quite a satisfactory germination. After drying, the seed is passed two or three times through the fan mill and is ready for market.

The cost of machine-dressing carrot and parsnip seed is an item which represents a considerable proportion of the cost of production. In carrot-seed it has cost us from 15 per cent. to 19 per cent., in parsnip 7 per cent., and in mangold 10 per cent., of the value of the finished product. Garden peas, on the other hand, cost only about 3 per cent. of their value in dressing. In machine-dressing carrot-seed there is approximately a 40-per-cent. loss in weight, due to the removal of the beard from the seed; while the loss in parsnip and mangold is about 5 per cent. to 7 per cent., and depends upon the amount of rubbish removed by the fan mill before the seed is machine-dressed.

RADISH AND LETTUCE.

We have grown radish-seed for three years, and have finally decided we cannot handle it profitably. Birds have always taken the greater part of the seed long before it is ready for harvest, and to save even half a crop we have to cut before it is mature. Threshing also offers difficulties which we have not been able to overcome with our mill.

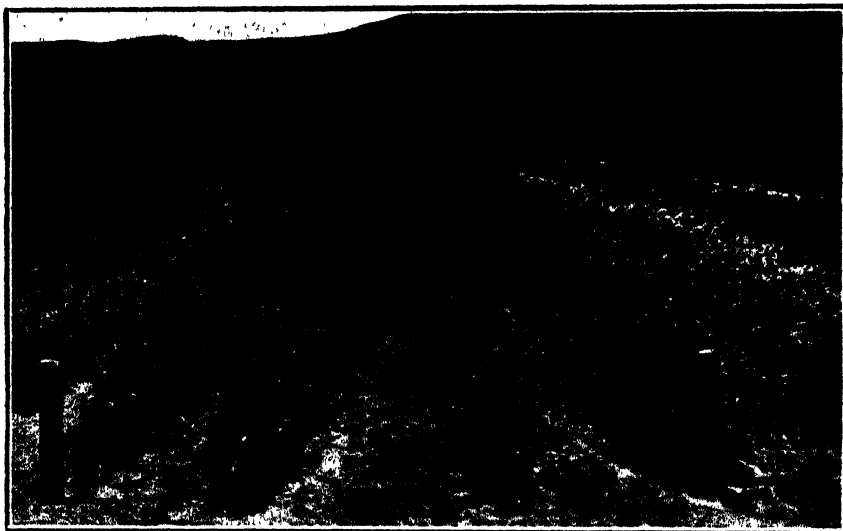


FIG. 6. GENERAL VIEW OF NAMED VARIETIES OF SWEET PEAS.

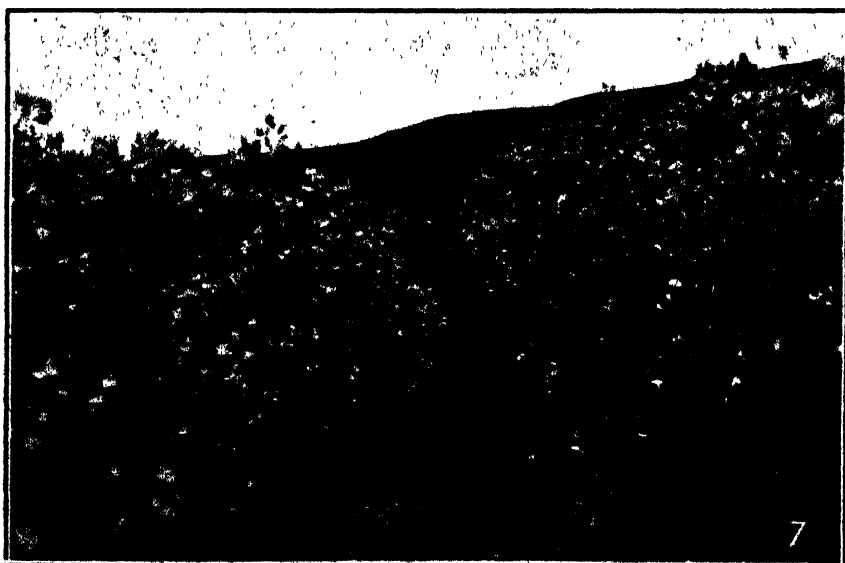


FIG. 7. NAMED VARIETIES OF SWEET PEAS GROWN ON STAKES.

We have also grown lettuce-seed experimentally for some years. It is a crop which does exceptionally well here and produces excellent hearts, but we have had no success with seed-production. The hearts require to be cut open to allow the seed-stalks to come through, and later the lower leaves are stripped off the plant. Even very early spring sowings have always failed to set seed, although the plants flower profusely, and we would attribute the failure to cold weather and light frosts about the time seed should be setting. Autumn sowing results in an earlier crop, and the seed sets, but the yield and quality are not up to a satisfactory standard, and we have practically decided to eliminate this crop also.

SHORT-CUTS IN SEED-GROWING.

There are methods of raising seed which might be most correctly described as short-cuts. Biennial crops do not require two full seasons to produce seed. Most roots such as turnips, carrots, and beet-root, if sown during the late summer, will form small-sized roots before the winter. These are very easily and economically handled, and can be set out in the spring with little expenditure of labour as compared with that required for planting large roots. These small roots seed quite satisfactorily, and thus afford a most economical method of production. Sowing in close drills a few inches apart is another means of raising small roots which are easily handled.

In growing parsnip-seed we incur a great deal of expense in harvesting, sorting, and transplanting the roots. This work is not essential, as these roots, and many others, could in most cases be allowed to seed where they grow.

Such methods afford a means of considerably reducing the cost of production, and their adoption, whether we like it or not, is probably inevitable if we are to successfully compete with imported seed.

One point, however, should be stressed, because it is of the greatest possible significance. These roots, whether left in the ground to seed or lifted and transplanted when quite small, cannot be satisfactorily examined and culled, and unless the grower adopts certain precautions the risk is too great, and he will produce seed which can at best be described as of very doubtful purity.

In the first instalment of this article the raising of stock seed was discussed, and where such a system is adopted with success the purity of this seed is such as to warrant the grower in taking the risk. After four years we have produced stock seed which we consider to be very superior, but we have not yet deemed it wise to dispense with culling and transplanting.

Another method, applicable, for example, to beet-root, is to reserve separately the seed from a large number of plants. A small sample from each is sown in the spring as a purity test. The rest of each sample is sown separately in the late summer. When these latter roots are ready for lifting, the purity and quality of each strain can be ascertained by examining the purity test of the sample sown in the previous spring, and those showing bad types are discarded. The loss in discarding these is not great, as the cost of producing the roots thus far is very little.

COST OF PRODUCTION.

The cost of production on the Moa Farm has been high, and one could hardly expect otherwise considering the methods we adopt at present. This statement is made in a general way, since we are not in a position to state just what is the cost of production of any one kind of seed. This is affected by many factors—mainly the yield—and we can do little more than indicate the price around which farmers would have to be prepared to grow for the seed-merchants in order to successfully compete with the price of imported seed. This information is tabulated below, together with other data which may be of interest. The writer is indebted to Mr. R. D. Nimmo, of Messrs. Nimmo and Blair, Dunedin, for assistance in arriving at certain of these figures. Free use has also been made of the American Seed Trade Buyers' Guide for 1924, published by *Seed World*.

Crop.	Approximate New Zealand Contract Price between Grower and Seed-mer- chant, 1924.	Average Price paid by American Importers f.o.b. Port of Origin, 1921-22 (Duty not included).	Average Yield per Acre on Moa Seed Farm.	Average American Yield per Acre, 1918-22.	Remarks.
	Per Pound. s. d. 0 10	Per Pound. s. d. 0 7	lb. 1,400	lb. 670	
Parsnip ..					N.Z. imports mainly from England, but large quantities produced locally for domestic use.
Carrot ..	1 3	1 3	500	470	N.Z. imports mainly from Britain, U.S.A., and France, and a considerable area grown in N.Z. for local use.
Beet ..	0 9	0 8	800	780	N.Z. imports mainly from Britain and U.S.A. Some also grown in N.Z.
Mangold ..	0 6	0 6½	1,200	860	N.Z. imports from Britain. Some also grown in N.Z.
Onion ..	2 6*	3 3†	‡	320	N.Z. imports cheaper varieties from Australia and more expensive sorts from Britain. Very little grown in N.Z.
Lettuce ..	3 6	No imports	‡	320	N.Z. imports from U.S.A. and the Continent. Not much grown in N.Z.
Radish ..	0 8	0 10	200§	225	N.Z. imports from U.S.A. and England. Not much grown in N.Z.
Garden peas	Per Bushel. 7 6||	..	Bushels. 25	Bushels. 14	No import trade. N.Z. exports annually about 75,000 bushels of garden peas, and this forms the main export line in garden seeds.

* Refers to cheap varieties, mainly Brown Spanish.

† Includes the more expensive varieties.

‡ Not recorded.

§ Difficult to estimate; we have harvested 400 lb. per acre, but most of our

crops have failed.

|| The price varies this season from 6s. 3d. to 10s. per bushel according to

variety.

AGRICULTURAL EDUCATION IN THE UNITED STATES.

THE WASHINGTON AND OREGON STATE COLLEGES.

Paper communicated to the New Zealand Board of Agriculture by Mr. JAMES BEGG, Otago member of the Board.

WHILE recently visiting the west coast of the United States I took the opportunity to see two of the State colleges which include in their activities a college of agriculture. The colleges of the States of Washington and Oregon were the most convenient for me to visit, and an additional inducement lay in the fact that climatic conditions there more nearly approximate to conditions in New Zealand than do those of any other States in the Union. The coast belt was originally covered with heavy forest, and is dairying and mixed-farming country with a heavy rainfall and a warm summer, and a winter that is free from the excessive cold of inland and eastern America; it is comparable to parts of our North Island. The central portion of these States is arid country with a 6 in. to 10 in. rainfall, hot summers and cold winters, very fertile under irrigation, and approximating the conditions in Central Otago. In the eastern belt the rainfall increases to 15 in. to 25 in.; the country is gently rolling, and is used principally for wheat-growing, resembling North Otago and Canterbury. The mountainous country is covered with forest at the higher levels, and a large number of sheep are grazed in these forest reserves. There is a growing fat-lamb industry on the irrigated lands bordering on the sheep-ranges.

To reach the little town of Pullman, where the State College of Washington is situated, it is necessary to travel right across that State to its eastern border. Coming from New Zealand, where the State institutions are nearly all placed in or near the large cities, it seemed strange to find this great College away in the extreme back country of the State. It seems that under State law in Washington no county can have two State institutions till each county possesses one. This law has many advantages. It distributes Government expenditure throughout the State, and tends to prevent congestion in any one centre. Centres of culture are formed remote from the big cities—it is believed that better work is done in colleges away from the distractions of city life.

Pullman has about three thousand inhabitants when the College is not in session, but with the opening of the latter the population doubles. There are two thousand five hundred students, and a very large faculty of professors and instructors. The College is housed in a group of fine buildings on a hill above the town, and overlooking a hundred miles of the richest wheat-growing country in the United States. The system adopted in these States is to have two State colleges, one devoted to the arts, medicine, law, &c., and the other dealing with the arts, music, and the applied sciences. Pullman and Corvallis are in the latter category. Each of the large colleges of agriculture in the Western States specializes in the direction of the requirements of its own State.

Thus the Washington College, at Pullman, gives special attention to wheat, dairying, and mixed farming on dry and irrigated lands; the Oregon College, at Corvallis, leans to dairying, fodder crops, small fruits, and irrigation; while the Berkeley College, in California, devotes a great deal of attention to irrigation and fruitgrowing.

Corvallis is a small town of five thousand inhabitants, situated about sixty miles south of Portland. It lies in the coastal region, which has a generous rainfall. Originally covered with heavy forest, the country has now been cleared, and is used for dairying and mixed farming. The College, like that of Pullman, is housed in a noble group of buildings placed on an estate of about 1,000 acres, which forms the campus, playing-fields, and experiment and demonstration farms. There are some three thousand students.

These colleges are equipped on a lavish scale, funds being provided from various sources. In the case of Pullman, what is known as the "mill-tax levy," which is a percentage of the State revenues, provides £350,000, land grants aggregating 190,000 acres yield £40,000, and other appropriations £50,000. In addition, there are Federal funds assigned to the College, amounting annually to £80,000. The colleges also enjoy numerous private bequests and scholarships, and have further sources of income from tuition fees, &c. It will be seen that the finance is provided for on a generous scale. The cost to a student for fees and board and lodging varies from £80 to £150 per annum. Students are encouraged to attend the college in their home State by substantial concessions in fees. For instance, at Pullman the tuition fee for residents of the State of Washington is 20 dollars, to non-residents of the State 150 dollars.

The following remarks apply to both Pullman and Corvallis Colleges: The subjects dealt with are agriculture, home economics, mechanical arts and engineering, sciences and arts, veterinary science, education, mines and geology, music and fine arts, pharmacy, military science and tactics. This variety gives a very full college life, and agriculture takes an honoured place in the calendar, which is as it should be, and as we hope it soon will be in New Zealand also. About half the students are women, the majority of whom are taking music and home economics; but I had the pleasure of meeting some who had taken a degree in agricultural science, one of whom occupied the position of instructor in soil-analysis and soil-survey. It was a little disappointing to find that only two hundred of the students were taking the agricultural course, but this was accounted for by the very bad times agriculture has been passing through in America. The normal proportion of students of agriculture in these colleges is about 20 per cent. of the whole, and the Principals were confident that the usual proportion would soon be restored.

Pullman College has an estate of about 600 acres attached to it, and this is devoted to experimental and demonstration work. Horses, beef and dairy cattle, sheep, and pigs are bred, and experiments both in breeding and feeding are carried on. Plant-breeding and experiments in growing pasture and fodder crops are conducted, also a vast amount of investigation work dealing with problems encountered by farmers in every corner of the State. The students get their training in a rural

atmosphere, and this, to my mind, is invaluable to the students of agriculture, also very beneficial to the students of the other arts and sciences taught in the College. The idea growing up in some quarters that the science of agriculture can be acquired as well in a city as in rural surroundings is a dangerous and pernicious idea, and is comparable to training a medical student in a college remote from hospitals, and without seeing any of the practical work of his profession.

The courses of study offered in this College are intended to give a thorough training in the field of agriculture as a science. The art or practice of agriculture as a vocation is not lost sight of, but the fundamental purpose of the work leading to the degree of Bachelor of Science is a mastery of the science itself. For this reason the work in agriculture is accompanied or preceded by as thorough training as possible in the sciences which underlie the principles of agriculture—botany, bacteriology, chemistry, physics, and zoology. In addition, English, education, economics, and other electives are given a prominent place, and the complete course is intended to equip the student with a well-balanced education. The completion of such a course prepares the student for intelligent practical farming, for farm-management and farm business, for landscape work, for practical forestry and range-management, for agricultural journalism, for investigating agricultural problems in connection with experiment-station work, for teaching agriculture and the allied sciences, and for extension service or for service in the United States Department of Agriculture. The demand for men trained to fill such positions far exceeds the supply.

Courses are offered in fourteen groups: General agriculture, farm crops, soils, animal husbandry, agricultural engineering, dairy husbandry, plant pathology, poultry husbandry, horticulture, general forestry, range-management, landscape gardening, agricultural journalism, and farm-management and farm business. The student will select the group he prefers, and must file a formal statement of his choice at the Dean's office before the end of the first semester of the junior year. While a candidate for a degree must complete all the required work prescribed in his chosen group, ample opportunity is afforded for selection of subjects from other groups. Students who do not plan to graduate, but desire special work, are given ample opportunity to select such groups of subjects as will best meet their needs, provided that subjects are selected for which the student is prepared.

The students of agriculture do not learn the ordinary work of farming at these colleges. Their time is regarded as much too valuable to be spent in learning how to plough and sow, and handle horses, but they spend a certain proportion of their time on the farm, seeing in practice the principles they have learned in the class-room, being taught how to conduct experiments with exactness, and learning how to pursue investigation to a final conclusion. Judging of live-stock is given an important place as cultivating close observation, training in exact judgment and reasoning, and also ability to state clearly and concisely in writing the reasons for the conclusions arrived at. It must not be inferred, however, that the practical work of farming is ignored. Students are required to get this practical knowledge either before entering the college or during the vacations. The agricultural school, as we know it at Lincoln and Ruakura, is conducted on different lines

to anything I saw in America. The practical work of farming is not taught at the colleges, and I did not hear of any institution where it was taught; it is not considered necessary institutionally.

During the five days I spent respectively at Pullman and Corvallis I had the opportunity of meeting a large number of the students of agriculture. They seemed a very fine body of young fellows, keen and intelligent, and very much interested in their work. Constant contact with students preparing for other walks in life gave them a wider outlook than would otherwise have been the case. They were practically all resident at the colleges, living either in residential quarters or in fraternity houses. These latter are managed by the students themselves, with nominal supervision by the college authorities, and seemed to be very well conducted.

I made inquiries as to what became of the students after taking their degree. Records are kept by the colleges, and information was available of the careers of about 80 per cent. of the graduates. Of these, about half occupied positions as County Agents and as instructors in high schools and colleges, and the other half were engaged in farming, being generally very successful. The large numbers who have only taken a partial course practically all become farmers, and it is found that they often become leaders in the districts in which they settle.

The colleges carry on extension services right through their States. This is done by means of the County Agents. These Agents are appointed by the County Councils from names submitted by the colleges. They are paid in part by the colleges, with subsidies from the County Councils and from the Federal Government. They must be college graduates, and have a practical knowledge of farming. Their duties are to instruct farmers, visit farms when necessary, give lectures to groups of farmers in the different centres, initiate and take charge of boys' and girls' clubs, and assist in promoting community fairs or shows. They have also to assist in solving farmers' problems, and when unable to deal with these to forward them to the college for investigation. They have to report monthly to the college authorities. By this means the college is kept in close touch with farming activities right through the State, and the tendency to become purely academic is checked.

The extension work is regarded as being most important. It is the connecting-link between the farmer and the college, and is the means of recruiting the future students. The members of the boys' clubs are found to be the students of agriculture of the future, but it must be remembered that this result is merely incidental. The object of extension work is to further educate the farmer of the present and the farmer of the future, so as to enable the men and boys on the land to get the benefit of the work carried on in the colleges, and to stimulate the desire for more knowledge. The underlying idea is one of service, and though these methods seem to have been used occasionally as a means of advertising a certain college, it is recognized that permanent success is not attained in this way.

When this system was first introduced the County Agents were regarded by farmers with suspicion, if not contempt, and it took many years to overcome this prejudice. This is now entirely changed. The Agent is welcomed everywhere, and is in such demand that the problem

now is how to supply the services required of him. In the State of Washington only six counties are now without an Agent, and these are remote and rugged districts where mining is the principal industry.

Under the care of the County Agents large numbers of boys' and girls' clubs have sprung up all over these States. The clubs are fostered by the high schools and also by the Chambers of Commerce. In a small country town I was able to see a show organized by a boys' and girls' club. The local Chamber of Commerce voted 60 dollars for some timber, and the boys built all the pens, hurdles, and stands themselves. There were capital exhibits of all kinds of farm stock—cows, ponies, porkers, sows with litters, poultry, honey, preserves, fruit, cereals, vegetables, &c. As far as I was able to gather each exhibit represented the work of the boys and girls. Parents' assistance was discouraged in every possible way. In the aggregate these clubs must represent an immense interest in rural affairs created in the minds of the young people. While extension work among the country community seems to be highly developed, I was assured by the college authorities that they are still only feeling their way, and have by no means finally decided which is the best method of interesting the country population in the higher branches of the science of agriculture.

Washington and Oregon were originally settled by an enterprising but rather ignorant type of farmer. The land is rich, and round Pullman the farmers have been growing wheat for forty years without fertilizers, and last year the whole district averaged 30 bushels to the acre. Little can be done with the older men, and it is the young men that are expected to adopt modern methods. It is very noticeable that they are doing so. The irrigation areas are largely in the hands of young men, and here good farming is the rule, the demand for expert teaching is keenest, and co-operative marketing is most highly developed. Many of the lads before leaving home and starting farming for themselves take a two-years course at the colleges in some special subjects.

During the winter months special courses of lectures are given at the colleges, but these have not been very well attended. It is found necessary to go out among the farmers and hold these instruction classes in the farming centres, a method closely resembling our winter schools of instruction for farmers. The extension service also employs a number of highly technically trained men and women who serve the farmers and their wives throughout the two States. The specialists in dairying, horticulture, soils and crops, farm-management, clothing, poultry, preserve-making, &c., work through the offices of the County Agents. Boys' clubs are encouraged to send teams of three to compete in judging stock at the State fairs. At the Yakima Fair, the most important show in the State of Washington, at which I was present, there was very keen competition among the clubs, and the president assured me that the boys' judging was wonderfully good. Young pedigree animals were awarded as prizes to the most successful of these boys. Extension work goes much further than this—indeed, it is carried on in the primary and secondary schools—but into these activities I had neither time nor opportunity to inquire.

The great problem of the agricultural colleges, of the experimental stations, and of the United States Department of Agriculture has been

that of getting the scientific agricultural knowledge acquired in these institutions into the hands of the farmers for practical use. The methods here described appear to be the best that have yet been devised, but it by no means follows that they cannot be improved upon. All extension work of the colleges is conducted in co-operation with the United States Department of Agriculture under the terms of an understanding entered into between the Department and the colleges. These arrangements are such that they now work without friction.

The college of home economics is closely associated with the college of agriculture, and its aim is largely to assist the wives and daughters of farmers. Its technical experts are scattered through the States, and their services are at the disposal of country women through the offices of the County Agents.

I may seem to have dealt more with the extension services than with the work in the colleges themselves, but have done so because I found that in the latter this was regarded as one of the most important branches of the college work.

Now that University Chairs of Agriculture are being established in New Zealand, steps must be taken to place the benefits of the work done in the hands of farmers. The Department of Agriculture must be placed in the closest touch with the colleges, and careers in the Department should be open to our graduates. What methods are best suited to our conditions in order to get the best results is a matter which will have to receive the attention of the Board of Agriculture very shortly. There must be no duplication of effort, and the colleges must be given the freest possible scope for developing their activities.

I would like to express my appreciation of the great hospitality shown to my wife and myself by the College authorities at Pullman and Corvallis. They did their utmost to make our visit both pleasant and instructive, and I can strongly recommend visitors from this country who can spare time to visit one or other of these colleges.

In conclusion, I would ask my colleagues on the Board to excuse these somewhat disjointed notes. I do not pretend to have had either time or opportunity for a close study of a very large and involved subject, but only hope these observations of a passing visitor on holiday will be of some little assistance in carrying out the work we have to do in our own country.

Blackberry Investigation.—The Director of the Fields Division records in his annual report for 1923-24 that a comprehensive set of experiments to discover means for the eradication or control of the blackberry was commenced during the year. These experiments are in the main being conducted in Wairoa County, Hawke's Bay. Blackberry-control constitutes a problem different in kind from that presented by any other weed in New Zealand, and involves a careful study of the plant in the field. The work being carried out includes the ploughing and regrassing of certain areas with a view to the replacement of the weed by useful grasses. On unploughable country an intensive study of the effects of goats is being carried out, and these animals give evidence of being most valuable in some localities in eradicating blackberry. Besides these experiments, others are being devised, employing chemical and biological means against the weed. Under biological means come insects and fungi, and all of these that are likely to be in any way valuable are being studied.

VIVANDIERE'S JERSEY RECORD.

THE DAILY AND CHECK MILK-WEIGHTS.

W. M. SINGLETON, Director of the Dairy Division.

WE are now able to report that Mr. A. Christie's Jersey cow, Vivandiere, has fully qualified for her certificate of record by calving subsequent to test, after the completion of her 365 days of authenticated milking. Two Jerseys and two Friesians have now received certificates under the New Zealand C.O.R. system on yields exceeding 1,000 lb. of butterfat. Details are as follows:—

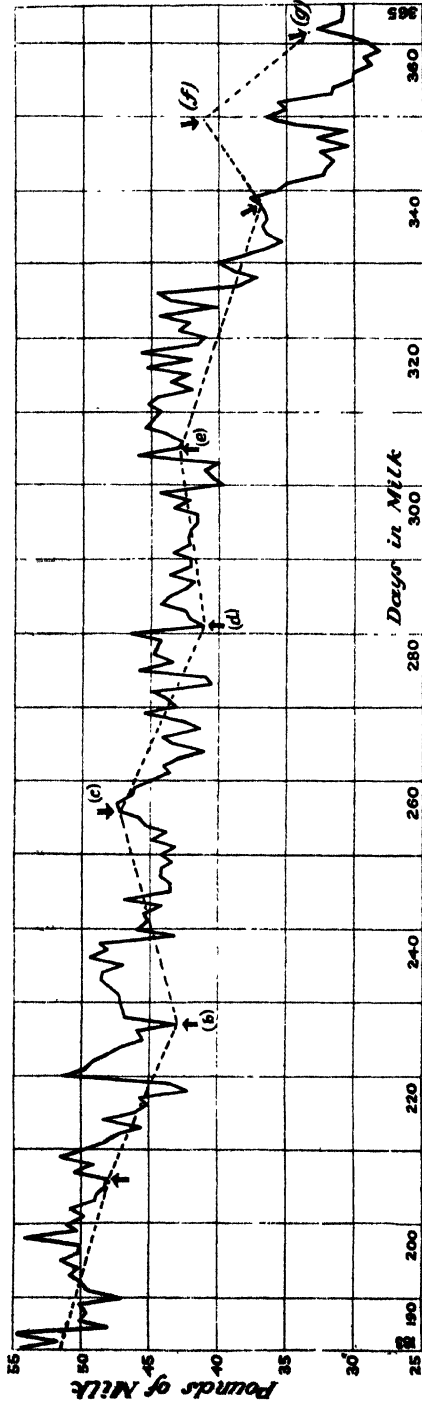
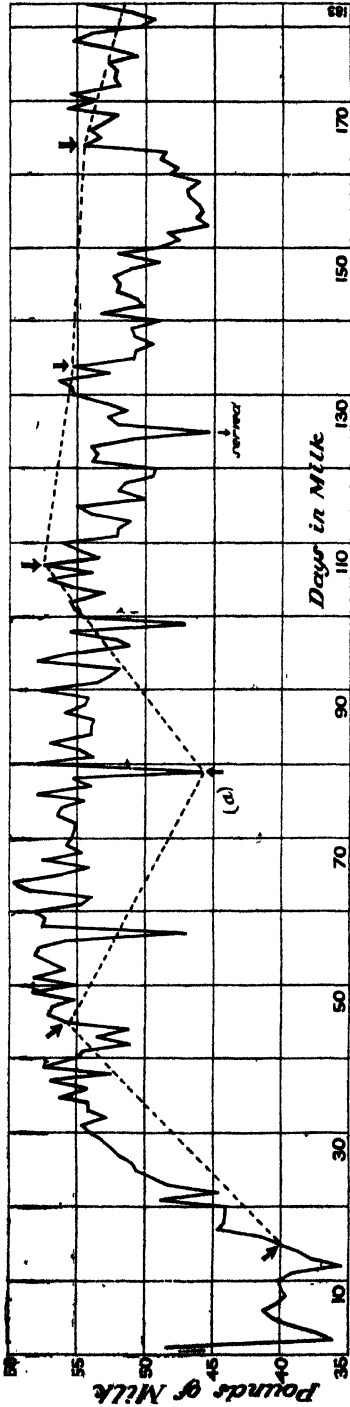
Table 1.

Name.	Days.	Milk.	Butterfat.	Age at Start of Test.
		lb	lb.	Yrs. days.
Alcartra Clothilde Pietje (Friesian) ..	365	31,312.5	1,145.24	7 357
Hilda Minto de Kol (Friesian) ..	365	27,773.8	1,046.31	12 56
Vivandiere (Jersey) ..	365	17,282.1	1,036.09	6 10
Pretty's Flirt (Jersey) ..	365	16,684.1	1,010.49	6 353

Vivandiere's milk-yield of 17,282.1 lb. also constitutes a New Zealand record for the Jersey breed.

The accompanying graph has been plotted from Vivandiere's daily milk-weights as supplied by the owner, and from the check weights taken by the Dairy Division's testing officer at the time of his visits. The spaces along the horizontal plane represent the days in milk, and the pounds of milk per day are plotted on the perpendicular scale. The daily weights are linked up by the unbroken line, and the dotted line joins the milk-tester's weights, the day of his check weighings being indicated by an arrow-head. The letters (a) to (d) signify that the Tester has reported to his head office a satisfactory reason for decline in milk-weights on, or just preceding, the date of his visit. As regards (f) and (g) where the point indicating the check weight on the day of the inspection visit is apart from the main line of the graph, it may be explained that in these cases the Tester happened to commence his sampling at the evening milking, and thus, while his figures would be for an evening and a morning milking, the owner's weights as linked up by the unbroken line are, of course, on the basis of the normal day.

The outstanding features of this graph are the well-maintained milk-flow, and the fact that the owner's milk-weights were well authenticated by the testing officer; in fact, in several instances the latter checked the milk-flow when it was around its maximum for the month. Another check which gives a good indication whether or not the owner's figures may be considered reasonable is to multiply the Tester's check weights by the test and to proportion out the result for the number of days in the month—that is, on the system of compiling herd-testing association



GRAPH SHOWING VIVANDIERE'S DAILY MILK-WEIGHTS DURING HER C.O.R. TEST PERIOD, 4TH AUGUST, 1923, TO 5TH AUGUST, 1924.
(See opposite page for explanation of letters and other signs.)

returns. Vivandiere's production on the day-by-day basis and on the association system is compared in the following table :—

Table 2. Comparison of C.O.R. and Association Results in Vivandiere's Record.

Month.	Days.	Check Weight.	Association Milk.	Test.	Association Fat.	C.O.R. Fat.	C.O.R. Milk.
		lb.	lb.		lb.	lb.	lb.
August ..	25	40·0	1,000·0	5·01	50·10	52·77	1,053·3
September ..	30	55·8	1,074·0	4·87	81·52	80·20	1,647·0
October ..	31	45·8	1,419·8	5·52	78·37	94·54	1,712·8
November ..	30	57·5	1,725·0	6·05	104·36	98·02	1,620·2
December ..	31	55·4	1,717·4	6·55	112·48	105·35	1,608·4
January ..	31	54·6	1,692·6	6·08	102·91	95·00	1,562·5
February ..	29	48·1	1,394·9	5·89	82·15	86·21	1,403·7
March ..	31	43·0	1,333·0	5·91	78·78	86·83	1,409·3
April ..	30	47·3	1,419·0	6·59	93·51	87·81	1,332·5
May ..	31	41·1	1,274·1	6·08	77·46	81·29	1,337·1
June ..	30	42·9	1,287·0	5·91	76·06	75·47	1,277·0
July ..	31	{ 36·9 41·1 }	1,209·0	7·70	93·09	80·28	1,042·7
August ..	5	33·3	166·5	7·92	13·18	12·32	155·6
Totals ..	..	..	17,312·3	..	1,043·97	1,036·09	17,282·1

It will be seen from this table that, based on the milk-weights recorded by the testing officer, the cow would have received credit for 30·2 lb. milk and 7·88 lb. fat more than she actually received on the C.O.R. system.

Table 3. List of World's Jersey Butterfat Records over 1,000 lb.

Name.	Milk.	Average Test.	Butterfat.	Days in Calf.	Age.	Times milked Daily.
					Yrs. mths.	
Darling's Jolly Lassie (U.S.A.)	16,425	6·95	1,141·28	196	4 0	3
Groff's Constance (U.S.A.) ..	17,942	6·30	1,130·09	↑	5 8	3
Princess Emma (U.S.A.) ..	18,437	6·02	1,109·99	↑	6 3	4
Lad's Iota (U.S.A.) ..	18,632	5·62	1,048·07	193	5 6	..
Plain Mary (U.S.A.) ..	15,256	6·82	1,040·08	182	8 11	3
Vive La France (U.S.A.) ..	15,272	6·81	1,039·29	261	5 11	..
Lady's Silken Glow (U.S.A.) ..	14,939	6·95	1,038·70	↑	7 1	..
Vivandiere (N.Z.) ..	17,282	6·00	1,036·09	240	6 0	2
St. Mawe's Lad's Lady (U.S.A.)	15,229	6·78	1,032·97	↑	4 2	..
Vive La France (U.S.A.) ..	14,926	6·91	1,031·64	175	4 7	..
Brown Lady's Little Jewel (U.S.A.)	18,318	5·57	1,019·73	↑	5 8	..
Pretty's Flirt (N.Z.) ..	16,684	6·06	1,010·49	244	6 11	3
Fauvic's Star (U.S.A.) ..	20,616	4·88	1,005·90	194	6 11	4
Eminent's Martha W. of St. Omer (Canada)	19,051	5·26	1,002·00	..	..	..
Sophie's Agnes (U.S.A.) ..	16,212	6·17	1,000·07	216	6 1	3

* Under the New Zealand C.O.R. rules a cow—provided she milks the full 365 days—must be in calf for not less than 192 days during the period of the test in order to qualify for a first-class certificate. † Did not qualify on subsequent calving.

In a brief note in last month's *Journal* we stated that Vivandiere had probably established a world's record on twice-a-day milking. Up to the present we have not been able to trace any reference which

disproves this statement. The Jersey breed, so far as our records show, now has fifteen 1,000 lb. butterfat records to its credit, and among these the New Zealand Jerseys, Vivandiere and Pretty's Flirt, fall eighth and twelfth in the list respectively. Details have been compiled in the accompanying Table 3, including the number of times daily each cow was milked, where known. It is interesting to recall that the first Jersey 1,000 lb. record was not completed until the 30th November, 1918, when Sophie's Agnes was credited with 1,000.07 lb. butterfat.

The sire of Vivandiere is Beachland's King Pin, bred by Messrs. A. Moreland and Son, of Te Rapa. His sire is Brighton Twylish, sire of seven C.O.R. daughters, and Brighton Twylish is in turn by the well-known imported sire, Lord Twylish, sire of ten C.O.R. daughters in New Zealand. On the female side Beachland's King Pin is from Golden Swan's Maid, a daughter of Golden Swan (Imp.), whose name is well known to our Jersey breeders.

The dam of Vivandiere is Loo, bred by Mr. E. Griffiths, of New Plymouth. She has a C.O.R. for 527.91 lb. fat, and is by Roberts (Imp.), sire of nineteen C.O.R. daughters. Roberts is two generations removed from Noble of Oaklands. On the dam's side Loo goes through Belvedere Bilberry and M.L.C. to K.C.B., who appears, three generations back, on both sides of her pedigree. Thus Vivandiere is a combination of many well-known and proven strains.

LOOSE SMUT OF WHEAT.

I. SEED-DISINFECTION BY HOT WATER.

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SINCE all the staple crops are propagated by seed, the first essential in obtaining clean crops is to plant seed free from disease. With many diseases reinfection of the seedling may occur from contaminated surroundings, but there are quite a number of others that are carried over from year to year entirely by means of infected seed. The most important diseases falling within the latter category are the cereal smuts, and it is on the problem of their control that the chief researches on seed-disinfection have been conducted. Certain of the smuts, such as stinking smut of wheat, loose smut of oats, and covered smut of barley, which infect by means of spores adhering to the outside of the seed grain, are readily controlled by chemical solutions and dusts, but others, such as the loose smut of wheat and the naked smut of barley, whose means of infection lie deeply buried within the seed, are not affected by treatments which reach the exterior only. Jensen showed, in 1887, that by the application of a certain degree of moist heat it is possible to eliminate this internal infection without materially injuring the seed.

Several subsequent workers have verified Jensen's results and improved on his methods, so that now some variation of the Jensen hot-water method is the standard control measure recommended by plant pathologists for the control of these latter smuts. The treatment also effectively prevents infection by externally carried spores

of the other smuts. The advantages of such a comprehensive treatment are offset by the difficulty of maintaining in practice the exact temperatures required, and for this reason, together with some uncertainty as to the best procedure, the method has had only a limited application. These disabilities do not appear insuperable, and the far-reaching possibilities offered by the method justify the present attempt to adapt it to practical farming in New Zealand. This article presents the results of certain experiments to that end.

THE MODIFIED JENSEN HOT-WATER TREATMENT.

The literature available here shows a good deal of variation in details of the methods recommended by different authors, as the following condensed summary will show :—

Table 1.

Author.*	Presoak in Water.		Treatment.		After-treatment.
	Duration.	Temperature.	Duration.	Temperature.	
Tubeuf ..	None ..	None ..	15 min.	130°-134° F.	Spread out to dry
McAlpine ..	None ..	None ..	5 min.	131°-135° ..	Ditto.
Güssow ..	4-6 hrs.	68°-86° F.	10 min.	124°-125° ..	"
Tisdale, &c. ..	4-6 hrs.	Cold water	10 min.	126° ..	"
Liro ..	4 hrs...	104° F. ..	10 min.	126°-128° ..	Dry quickly at about 104°
„ (alternatively)	None ..	None ..	12 hrs.	104° ..	Ditto.
Freeman, &c. }	5-7 hrs.	63°-72° F.	10 min.	129.2° ..	{ Spread out to dry.
Brown .. }					

* See "Literature consulted," at end of article.

Unfortunately, very few of these authors give details of the experimental data on which the recommendations are based, and the publications of the Danish and German workers who have most thoroughly investigated the subject are not available here. It has been necessary, therefore, to investigate systematically the effect of hot water on (1) the seed, and (2) the smut. This article is concerned with an investigation into the effects on speed and power of germination caused by certain of the factors involved in the standard methods of treatment. The germinations were conducted in the Biological Laboratory, using a single variety of wheat.

PLAN OF THE EXPERIMENTS.

The method may be divided into three stages: (1) Preliminary treatment, here called presoaking; (2) treatment proper, here called dipping; (3) after-treatment, here called drying.

The factors to be considered in each of these stages are: (1.) Pre-soaking—(a) duration, (b) temperature. (2.) Dipping—(a) duration, (b) temperature. (3.) Drying—(a) rapidity, (b) temperature, (c) duration of storage.

The wheat used was a machine-threshed sample of Major, harvested in February of this year by Mr. T. R. Willis, of "Woodendean," Greatford,

Rangitikei. The crop was badly infected with loose smut, which, by Mr. Willis's estimate, reduced the yield of grain by about 25 per cent.; it had a large percentage of undersized grain, 38 per cent. passing through a 2.5 mm. by 12 mm. sieve. Broken grains were not included in the samples tested, which otherwise were a fair sample of the whole. The treatments were carried out in wire baskets in a 5-gallon galvanized-iron vessel, using a single standardized thermometer. Great care was taken to obtain exactitude in both temperatures and times, a reliable thermostat being used for the longer tests.

Germinations were conducted between damp blotting-paper on a substratum of saturated felt, the temperatures ranging from 50° to 60° at night, and from 65° to 70° in the daytime. Germination was recorded on the appearance of both a root and a shoot, irrespective of size. The probable error of the mean percentage was computed by means of Bessel's formula

$$P_r = \pm 0.67 \sqrt{\frac{\sum d^2}{n(n-1)}}$$

Unless otherwise stated all treated seeds were dried for four to six hours in air-current at 95° to 104°, and placed in germinators on the following day. All temperatures are given in the Fahrenheit scale.

EXPERIMENTAL RESULTS.

The average germination of the dry untreated wheat (determined on 1,700 seeds germinated at different times during the experiments) was—three-day count, 73.41 ± 3.67 ; six-day count, 98.35 ± 0.28 ; nine-day count, 98.47 ± 0.24 .

(1.) *Presoaking.*

The effect on the seed of the duration and temperature of the presoak is shown in Tables 2 and 3 respectively.

In reference to Table 2, taking the presoak of five to six hours at 63° as the standard, and comparing it with samples subjected to identical treatment but which had not been presoaked, the germination capacity is about equal under dips up to ten minutes at 127°. Above 127° the presoaked seed rapidly declines in vitality, till at 135° no germination takes place, while the non-presoaked seed still gives a germination of 91.3 per cent. in nine days. Comparing the presoak of sixteen to seventeen hours with the standard five to six hours, both at 63° and followed by a dip of five minutes, there is no appreciable difference in the total germination up to 131°, though above 123° there is a considerable retardation with the longer presoak. Above 131° this retardation becomes more marked and the total germination is considerably lower.

Only two temperatures of presoak are compared in Table 3—63° and 84°—the time in both cases being five to six hours. The rapidity of germination is considerably greater following the higher temperature presoak than following the lower, while the total germination is about equal up to 129° with the five-minute dip, and up to 127° with ten-minute dip. Above these temperatures both speed and power of

Table 2. Showing Effect on Seed of Duration of Presoak.

Temp.	No presoak; dipped 10 min.						Presoaked 16-17 Hours at 63°; dipped 5 min.					
	3-day Count.		6-day Count.		9-day Count.		3-day Count.		6-day Count.		9-day Count.	
	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.
121° ..	50	..	97	..	97	..	87	..	90	..	90	..
	50	51	97	96	99	97.3	86	86	98	94.7	99	95.6
	53	..	94	..	96	..	85	..	96	..	98	..
	..	±4.6	..	±0.4	..	±0.3	..	..	..	..	..	..
	..	47.7	..	95.8	..	97.1	..	..	..	..	..	..
123° ..	45	..	96	..	96	..	82	..	98	..	98	..
	43	43	94	96	95	96.7	85	82.3	98	97.7	98	98.3
	41	..	98	..	99	..	79	..	97	..	99	..
	..	±5.6	..	±0.3	..	±0.3	..	±4.5	..	±0.2	..	±0.2
	..	47.2	..	97.7	..	98.7	..	70.4	..	98	..	98.9
125° ..	25	..	94	..	98	..	26	..	97	..	99	..
	23	24.6	94	95	96	97.3	36	31	97	97	98	98.7
	26	..	97	..	98	..	31	..	97	..	99	..
	..	±4.6	..	±0.4	..	±0.2	..	±3.8	..	±0.5	..	±0.3
	..	29.8	..	95.6	..	98.2	..	66.5	..	97	..	98.1
127° ..	19	..	95	..	96	..	14	..	98	..	98	..
	16	17.3	97	96.3	98	97.7	14	14.7	99	98	99	98
	17	..	97	..	99	..	16	..	97	..	97	..
	..	±4.5	..	±0.8	..	±0.4	..	±5.0	..	±0.3	..	±0.3
	..	24.2	..	94.3	..	97.6	..	43.6	..	95.7	..	97.4
129° ..	12	..	94	..	98	..	0	..	92	..	98	..
	13	13	92	92.6	99	97.7	0	0	91	91.6	96	96.7
	14	..	92	..	96	..	0	..	92	..	96	..
	..	±1.2	..	±1.9	..	±0.4	..	±3.0	..	±0.7	..	±0.4
	..	3	..	75.6	..	94.2	..	27.7	..	94.3	..	97.3
131° ..	5	..	93	..	96	..	0	..	63	..	92	..
	6	5.7	91	92.3	97	97.3	0	0	78	67.3	93	92.3
	6	..	93	..	99	..	0	..	61	..	92	..
	..	..	..	±4.5	..	±2.2	..	±4.1	..	±1.4	..	±0.5
	..	0	..	35.9	..	72	..	19.6	..	85.8	..	93.1
133° ..	0	..	84	..	91	..	0	..	28	..	75	..
	0	0	72	81.6	86	91	0	0	25	27	75	74.6
	0	..	89	..	96	..	0	..	28	..	74	..
	..	..	..	±1.3	..	±2.2	..	±1.1	..	±5.4	..	±2.1
	..	0	..	3.5	..	17.3	..	3.3	..	50.2	..	83.1
135° ..	0	..	71	..	92	..	0	..	0	..	18	..
	0	0	65	73.3	88	91.3	0	0	0	0	15	16.3
	0	..	84	..	94	..	0	..	0	..	16	..
	..	..	..	..	..	..	..	..	..	±2.3	..	±2.9
	..	0	..	0	..	0	..	0	..	14.2	..	56.9
137° ..	0	..	33	..	63	..	0	..	0	..	0	..
	0	0	46	38.3	81	70	0	0	0	0	0	0
	0	..	36	..	66	..	0	..	0	..	0	..
	..	..	..	..	..	..	..	..	..	±0.7	..	±2.1
	..	..	..	..	..	..	..	0	..	2.4	..	31.1

NOTE.—The figures in italics are extracted from Table 4. Those in the left-hand columns are the means of the ten-minute dips; those in the right-hand columns are the means of the five-minute dips. In both cases the seed has been presoaked five or six hours at 63°.

Table 3. Showing Effect on Seed of Temperature of Presoak.

Temp.	Presoaked 5-6 Hours at 84°; dipped 5 min.						Presoaked 5-6 Hours at 84°; dipped 10 min.					
	3-day Count.		6-day Count.		9-day Count.		3-day Count.		6-day Count.		9-day Count.	
	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.	Germ.	Mean.
Not dip'ed	..	..	..	..	..	..	97	..	99	..	99	..
	..	..	..	..	..	..	99	97.7	99	98.3	99	98.6
	..	..	..	..	..	..	97	..	97	..	98	..
	..	..	..	..	..	..	..	± 1.6	..	± 8.3	..	± 0.3
	..	..	..	..	..	..	..	87.5	..	97.1	..	97.1
	..	..	..	..	..	..	96	..	99	..	99	..
	..	..	..	..	..	..	96	96.7	97	98.3	98	98.7
121°	..	..	..	..	..	..	98	..	99	..	99	..
	..	..	..	..	..	..	..	± 4.6	..	± 0.4	..	± 0.3
	..	..	..	..	..	..	..	47.7	..	95.8	..	97.1
	87	..	99	..	99	..	84	..	98	..	98	..
123°	87	88.7	99	98.3	99	98.3	89	88	99	98.3	99	98.7
	92	..	97	..	97	..	91	..	98	..	99	..
	..	4.5	..	± 0.2	..	± 0.2	..	± 5.6	..	± 0.3	..	± 0.3
	..	70.4	..	98	..	98.9	..	47.2	..	97.7	..	98.7
	92	..	98	..	98	..	67	..	96	..	97	..
125°	94	91.3	99	99	99	99	72	72	98	97.7	98	98
	88	..	100	..	100	..	77	..	99	..	99	..
	..	3.8	..	± 0.5	..	± 0.3	..	± 4.6	..	± 0.4	..	± 0.2
	..	66.5	..	97	..	98.1	..	29.8	..	95.6	..	98.2
	82	..	97	..	97	..	65	..	97	..	97	..
127°	92	87.7	98	98.3	98	98.3	64	61	96	96	96	96.3
	89	..	100	..	100	..	53	..	95	..	96	..
	..	± 5.0	..	± 0.3	..	± 0.3	..	± 4.5	..	± 0.8	..	± 0.4
	..	43.6	..	95.7	..	97.4	..	24.2	..	94.3	..	97.6
	79	..	98	..	98	..	23	..	93	..	97	..
129°	86	81.7	98	97.7	99	98.3	17	20	96	94.3	96	96
	80	..	97	..	98	..	20	..	94	..	95	..
	..	± 3.0	..	± 0.7	..	± 0.4	..	± 1.2	..	± 1.9	..	± 0.4
	..	27.7	..	94.3	..	97.3	..	3	..	75.6	..	94.2
	39	..	95	..	98	..	6	..	56	..	87	..
131°	38	37	94	94.3	97	97.3	7	6.7	68	64.3	84	85.7
	34	..	94	..	97	..	7	..	69	..	86	..
	..	± 4.1	..	± 1.4	..	± 0.4	..	..	..	± 4.5	..	± 2.2
	..	19.6	..	85.8	..	93.1	..	0	..	35.9	..	72
	5	..	78	..	94	..	0	..	14	..	44	..
133°	4	4.7	78	77.3	93	94.0	0	0	8	11	34	39.3
	5	..	76	..	95	..	0	..	11	..	40	..
	..	± 1.1	..	± 5.4	..	± 2.1	..	..	..	± 1.3	..	± 2.2
	..	3.3	..	50.2	..	83.1	..	0	..	3.5	..	17.3
	0	..	7	..	40	..	0	..	0	..	0	..
135°	0	0	11	7.7	43	40.3	0	0	0	0	2	0.7
	0	..	5	..	38	..	0	..	0	..	0	..
	..	..	..	± 2.3	..	± 2.9	..	..	..	..	..	..
	..	0	..	14.2	..	56.9	..	0	..	0	..	0
	0	..	0	..	1	..	..	..	..	..	..	..
137°	0	0	0	0	3	1.7	..	..	..	..	..	..
	0	..	0	..	1	..	..	..	..	..	..	..
	..	..	..	± 0.7	..	± 2.1	..	..	..	..	..	..
	..	0	..	2.4	..	31.1	..	..	..	..	..	..

NOTE.—The figures in italics are extracted from Table 4. Those in the left-hand columns are the means of the ten-minute dips; those in the right-hand columns are the means of the five-minute dips. In both cases the seed has been presoaked five to six hours at 63°.

germination are greater with the 84° presoak, except in the case of the five-minute dip at 135° and 137° , where there is a reversal in favour of the 63° presoak. Consultation of Table 4 will show that the high germination at 135° and 137° of the 63° presoak is due to the abnormally high result from one group of three samples, so that, on the whole—at least up to the point where germination becomes seriously affected—a presoak temperature of 84° is less injurious to the vitality of the seed than is a presoak temperature of 63° when the germination is commenced on the day following the treatment.

(2.) *Dipping.*

The effect of dipping or treatment proper on the seed, as regards the factors of duration and temperature of the dip, is set out in Table 4, and illustrated in Figs. 1 and 2. Fig. 1 shows graphically the total germinations given in Table 4. With a presoak of five to six hours at 63° no reduction is caused up to ten minutes at 127° or five minutes at 129° . At 129° and 131° respectively there is a reduction of 3 to 4 per cent., and beyond these points the fall is extremely rapid. The speed and vigour of germination, however, are adversely affected by all the dips in direct proportion to their time and temperature. The strength is illustrated by the photograph, Fig. 2, taken after six days' germination of similar samples—the stronger quite untreated, the weaker presoaked six hours at 84° , and dipped ten minutes at 127° . Both had an actual germination of 98 per cent. when the photograph was taken.

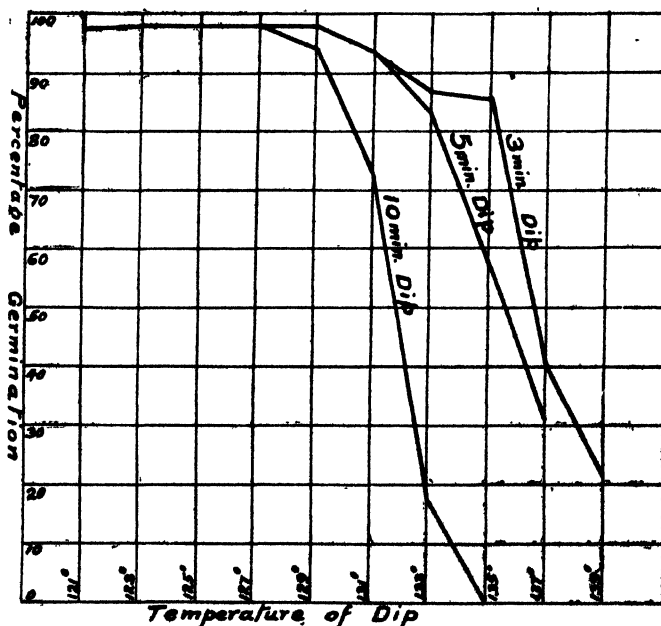


FIG. 1. SHOWING GRAPHICALLY THE TOTAL GERMINATIONS GIVEN IN TABLE 4.

Table 4. Showing the Effect of Dipping on the Seed as regards Duration and Temperature of Dip.
(Seed presoaked five to six hours at 63°.)

Temperature	121°.			123°.			125°.			127°.			129°.		
Counts in Days	3.	6.	9.	3.	6.	9.	3.	6.	9.	3.	6.	9.	3.	6.	9.
3-min. dip	..	..	..	70	99	100	53	94	97	34	97	98	20	97	98
	..	..	..	69	96	97	42	97	99	44	98	98	26	97	98
	..	..	..	66	96	97	56	100	100	32	97	98	25	96	97
	..	..	..	86	98	99	80	92	95	63	94	96	38	95	97
	..	..	..	84	97	98	80	97	98	60	95	98	38	90	96
5-min. dip	..	..	..	81	96	98	76	96	98	63	94	96	35	90	95
	..	..	..	91	99	100	81	96	97	61	97	98	40	98	99
	..	..	..	90	99	99	81	95	98	62	98	99	36	98	99
	..	..	..	87	98	99	81	98	98	61	96	98	33	100	100
	..	..	..	43	98	98	56	99	99	19	98	98	14	95	99
10-min. dip*	..	..	..	42	97	98	38	98	98	15	96	98	10	93	97
	..	..	..	54	100	100	48	99	100	15	95	95	10	92	94
	..	..	..	46	98	100	44	100	100	17	94	98	13	92	97
	..	..	..	19	98	100	14	92	99	5	92	96	0	76	93
	32	93	95	25	97	98	13	98	100	10	92	97	0	77	94
	35	98	98	52	99	100	29	95	97	28	98	100	2	91	97
	37	98	98	34	96	97	28	99	99	29	100	100	0	87	95
	46	99	99	46	99	99	25	95	96	14	97	98	0	75	92
	56	95	97	57	99	99	65	93	98	7	87	94	0	78	91
	82	95	96	94	98	99	65	93	98	69	95	99	19	77	95
	89	94	98	88	95	96	74	94	97	52	91	97	9	61	96
	30	96	97	32	98	99	20	97	99	7	96	97	0	65	94
	43	97	98	25	98	100	12	96	99	21	95	98	0	69	95
Means of above Results.															
3-min. dip	..	..	..	68.3	97	98	50.3	97	98.6	36.6	97.3	98	23.6	96.6	97.6
5-min. dip	..	..	..	±4.5	±0.2	±0.2	±3.8	±0.5	±0.3	±5	±0.3	±0.3	±3	±0.7	±0.4
	..	..	..	70.4	98	98.9	66.5	97	98.1	43.6	95.7	97.4	27.7	94.3	97.3
10-min. dip	±4.6	±0.4	±0.3	±5.6	±0.3	±0.3	±4.6	±0.4	±0.2	±4.5	±0.8	±0.4	±1.2	±1.9	±0.4
	47.7	95.8	97.1	47.2	97.7	98.7	29.8	95.6	98.2	24.2	94.3	97.6	3	75.6	94.2

* These figures are extracted from the results of the duration of storage tests up to thirty-one days given in Table 6. Though not strictly comparable with the other results in the table, on which germination was commenced on the day following treatment, yet, since the delay had no appreciable effect, they have a distinct comparative value.

Table 4. Showing the Effect of Dipping on the Seed as regards Duration and Temperature of Dip—continued.
(Seed presoaked five to six hours at 63°.)

Temperature ..	131°.			133°.			135°.			137°.			139°.		
Counts in Days ..	3.	6.	9.	3.	6.	9.	3.	6.	9.	3.	6.	9.	3.	6.	9.
3-min. dip	3	86	96	0	56	87	0	33	87	0	7	39	0	0	23
	6	83	92	0	56	87	0	39	83	0	7	42	0	0	23
	10	86	93	0	61	85	0	42	86	0	4	40	0	0	18
	47	93	95	13	78	90	0	31	79	0	8	44	..	..	..
	44	93	97	8	65	90	0	30	71	0	8	47	..	..	..
5-min. dip	42	89	94	12	68	90	0	29	74	0	4	45	..	..	..
	21	89	94	0	69	94	0	8	56	0	1	25	..	..	..
	23	91	93	0	68	87	0	9	53	0	0	30	..	..	..
	19	87	93	0	70	91	0	12	60	0	2	27	..	..	..
	0	83	94	0	20	77	0	7	43	0	0	22	..	..	..
10-min. dip*	0	74	92	0	22	67	0	5	44	0	1	23	..	..	..
	0	82	91	0	21	74	0	5	43	0	0	21	..	..	..
	0	77	88	0	21	71	0	6	46	0	0	27	..	..	..
	0	80	79	0	0	19	0	0	0	..	..	..	..	..	..
	0	30	79	0	0	17	0	0	0	..	..	..	..	..	..
10-min. dip*	0	17	53	0	4	15	0	0	0	..	..	..	..	..	..
	0	20	62	0	0	12	0	0	0	..	..	..	..	..	..
	0	70	75	0	11	31	0	0	0	..	..	..	..	..	..
	0	78	89	0	18	39	0	0	0	..	..	..	..	..	..
	0	26	75	0	0	5	0	0	0	..	..	..	..	..	..
10-min. dip*	0	22	68	0	2	15	0	0	0	..	..	..	..	..	..
	0	29	63	0	0	5	0	0	0	..	..	..	..	..	..
	0	36	76	0	0	15	0	0	0	..	..	..	..	..	..
Means of above Results.															
3-min. dip	6.3	85	93.6	0	57.6	86.3	0	38	85	0	6	40.3	0	0	21.3
5-min. dip	±4.1	±1.4	±0.5	±1.1	±5.4	±2.1	..	±2.3	±2.9	..	±0.7	±2.1	..	..	..
10-min. dip	19.6	85.8	93.1	3.3	50.2	83.1	0	14.2	56.9	0	2.4	31.1	..	..	..
10-min. dip	0	±4.5	±2.2	0	±1.3	±2.2	..	..	..	..	..	..	..	..	..
10-min. dip	0	35.9	72	0	3.5	17.3	0	0	0	..	..	..	..	..	..

* These figures are extracted from the results of the duration of storage tests up to thirty-one days given in Table 6. Though not strictly comparable with the other results in the table, on which germination was commenced on the day following treatment, yet, since the delay had no appreciable effect, they have a distinct comparative value.



FIG. 2. SIX-DAY GERMINATION OF TWO SIMILAR SAMPLES OF SEED.

To left, untreated; to right, presoaked six hours at 84° F. and dipped ten minutes at 127°. Both samples had an actual germination of 98 per cent.

[Photo by H. Drake.

(3.) Drying.

Experiments in drying or after-treatment of the seed, as regards rapidity and temperature, are presented in Tables 5 and 6.

Table 5.

(Seed presoaked six hours at 63°, and not dipped.)

Germination menced	com- Count in }	Without Drying.			Spread out Overnight.			Six Hours in Air-current at 95°-100°.		
		3.	6.	9.	3.	6.	9.	3.	6.	9.
..		95	97	97	98	99	99	55	99	99
..		97	98	99	95	97	97	57	93	95
..		98	100	100	94	97	97	54	97	98
..		96	99	99	95	97	97	77	98	99
..		97	99	99	97	98	98	86	99	99
Mean	96.6	98.6	98.8	95.8	97.6	97.6	65.8	97.2	98.0

Under the conditions of the experiment set out in Table 5 (seed presoaked six hours and not dipped) the samples which were put to germinate at once without any drying came away rapidly and gave a high total germination. The samples which were left spread out and exposed to the air of the laboratory overnight came away almost as well, but did not give quite so high a total germination. The ungerminated seeds of these latter samples almost all showed a growth of *Penicillium* and *Rhizopus* moulds. The samples dried for six hours in an air-current at 95° to 100° showed a considerable delay in commencing germination, but, with the exception of one sample, gave as high a total germination as the samples which were not dried or as the entirely untreated seed. In the sample mentioned, of the five ungerminated seeds remaining after the nine-day count, three showed a strong growth of *Penicillium* sp. A great deal more work must be done on methods of drying before any reliable generalizations can be made.

The whole of the samples shown in Table 6 were treated in bulk on 8th May, dried in air-current at 95° to 100° for six hours, then counted out and stored in paper packets in the laboratory. It appears from the tabulated results that the vitality of this line of seed is not appreciably affected by storage after presoaking, dipping, and drying—at any rate up to a month.

ANOTHER METHOD.

One other method of hot-water treatment—namely, a dip of twelve hours at 104°, without presoak, and dried four hours in air-current at 100° to 105°—was tried on 300 seeds, the results on germination being as follows:—

Three-day count = 74, 78, 84 : mean = 75.3.
 Six-day count = 94, 93, 95 : mean = 94.0.
 Nine-day count = 96, 95, 95 : mean = 95.3.

SUMMARY.

(1.) Presoaking in itself does not appear to injure the vitality of the seed, but renders it more sensitive to the action of the higher temperatures in the subsequent dip.

(2.) There is a slight advantage in a presoak temperature of 84° over a temperature of 63° for five to six hours when germination is commenced on the day following treatment.

(3.) With a presoak of five to six hours at 63° the total germination is unaffected by a subsequent dip of ten minutes up to 127°, or five minutes up to 129°. A reduction of 3 to 4 per cent. takes place in each case by a further rise of 2°, and a rapid reduction with a still further rise.

(4.) The germination speed is in all cases lowered in direct proportion to increase in both time and temperature of dip.

(5.) Drying quickly, following treatment, in an air-current at 95° to 100° has no injurious effect on germination, nor, when treated seeds are thus dried, is there any loss of vitality after storage up to one month.

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MARTON EXPERIMENTAL AREA.

NOTES ON OPERATIONS, SEASON 1923-24.

J. W. DEEM, Instructor in Agriculture.

THE 1923-24 season in the Marton district was one of the poorest cropping seasons, so far as weather is concerned, that has been experienced for many years, and this was fully reflected in the poor grain-yields recorded all over the district. In the autumn of 1923 very wet weather set in, and these conditions continued right through the winter and well into the spring. This was followed by an excessively dry spell in November and December. Owing to the wet conditions very little autumn or winter ploughing could be done. It was September before much spring ploughing could be carried out, and the land, through lying wet and sodden all the winter, turned up in very bad condition, being particularly bad on areas where autumn fodder crops had been fed off. The dry weather following suddenly on the wet conditions, caused the land to dry quickly into hard lumps; consequently it was impossible in many instances to prepare a satisfactory seed-bed. Wet conditions set in again early in the New Year, but, although this was bad for harvesting, the extra growth of grass went a long way towards compensating for poor root and grain crops.

CROPS.

A much larger portion of the Marton Experimental Area than usual is now in pasture for the purpose of building up fertility and conducting various top-dressing experiments; consequently the area under crops in the past season was smaller than for some years past. It consisted of 7 acres of Algerian oats, $2\frac{1}{2}$ acres of wheat, $2\frac{1}{2}$ acres of Black Skinless barley, 4 acres of vetches, 2 acres of peas, and 2 acres of swedes—a total of $19\frac{1}{2}$ acres. In addition, 1 acre of genuine imported wild white clover and $\frac{1}{2}$ acre of *Phalaris bulbosa* were sown.

Cereals.—The oat crop was patchy, parts being badly affected with red-leaf. The crop was sown on 17th September with 2 cwt. of 36-38 per cent. super per acre, and harvested on 8th January, yielding $1\frac{1}{2}$ tons of good-quality chaff per acre. The wheat consisted of half Major and half Marquis, and, being only a small area, suffered badly from birds. The crops were sown on 18th September with 2 cwt. super per acre; they ripened evenly, and were harvested on 10th January. Marquis threshed $26\frac{1}{2}$ bushels and Major 20 bushels of milling-grain per acre. The Black barley was sown on 9th October at the rate of $2\frac{1}{2}$ bushels, with half Nauru phosphate and half super at 2 cwt., per acre. It was rather a wet piece of land, but the barley grew fairly well, and was harvested on 10th January and yielded $28\frac{1}{2}$ bushels per acre.

Peas.—The 2 acres of Early Minto peas were sown on 9th October at the rate of 3 bushels, with 1 cwt. Nauru phosphate and 1 cwt. super, per acre. The peas germinated well and made splendid growth. They were cut on 20th January; conditions were not very good for harvesting, and a great many were shaken out on the ground during the process of saving. The threshed yield was $27\frac{1}{2}$ bushels per acre.

Vetches.—These consisted of 2 acres each of Golden and Grey, which were sown on the same date as the peas, at the rate of $2\frac{1}{2}$ bushels per acre. They grew well and promised a heavy crop, but owing to bad weather at harvest fully half the crop was lost. The yields were—Golden, $14\frac{1}{2}$ bushels, and Grey, $11\frac{1}{2}$ bushels, per acre.

Swedes.—Two acres of land adjoining the experimental area were acquired late in the season, and this was ploughed at once and sown in five varieties of swedes as a disease-resistance test. Owing to the late ploughing and dry spring none of the varieties gave a heavy crop. No club-root was found, but four out of the five varieties were affected with dry-rot to the extent of 7 per cent., the exception being Vilmorin's White-fleshed Purple-top, which appeared quite free. Following were the yields of roots per acre: Vilmorin's White-fleshed Purple-top, 21 tons 10 cwt.; Irvine's Purple-top, 11 tons 17 cwt.; Bangholm Purple-top, 11 tons 8 cwt.; Sutton's Hardy White (white-fleshed), 11 tons 5 cwt.; Nimmo and Blair's Royal Purple, 10 tons 8 cwt. The Vilmorin roots forked badly and looked rough, but were very palatable, and produced practically double the feeding of any of the other varieties.

Wild White Clover.—This was sown on 1st November, and came away slowly, but has now covered the ground nicely. It is too soon to hazard an opinion as to how it will compare with colonial wild white.

Phalaris bulbosa.—The seed was sown in the autumn, and it appears to have germinated well. It is proposed to grow this for a seed crop.

PASTURES.

An 11-acre field of temporary pasture closed in October for hay purposes was found later to be carrying a fair crop of rye-grass, and it was decided to cut it for seed. The crop was harvested with a reaper-and-binder on 3rd January, stooked straight away, and threshed from the stook on 11th January, yielding 19 bushels of seed per acre. The field was sown on 26th April, 1921, and top-dressed with various manures during the first week of August the same year. Prior to the crops being cut in the 1922-23 and 1923-24 seasons, weighings of the green material were taken, and resulted as follows:—

				1922-23.	1923-24.	Total.
				Tons cwt.	Tons cwt.	Tons cwt.
Basic slag, 3 cwt.	..	..	..	12 9	6 8	18 17
Nauru phosphate, 3 cwt.	..	..	..	10 11	6 19	17 10
50 per cent. phosphate, 3 cwt.	..	..	..	13 11	6 16	17 7
Control (no manure)	..	..	..	10 11	6 5	16 6

These weighings represent a growth of about seventy days each year—October to December. The lighter weighing in 1923-24 is partly accounted for by the late growth of clover; the clover came away after the rye-grass had been removed, and produced a wonderful aftermath. This field, in addition to producing the cut of grass-seed, carried an average of 3.75 sheep per acre for the whole year, and would easily have carried five sheep had they always been available when required.

Five acres of temporary pasture sown in 1918, and cut each year since for hay, was again shut up on 11th October, and cut and weighed on 4th December. As mentioned in last year's notes, this area was divided up and some top-dressing done in 1922 at the rate of 2 cwt. per acre, with the exception of plot 4, which was top-dressed with 2 cwt. super per acre in 1921 and again in 1923. The following table gives the results in green material of the 1922 and 1923 weighings:—

Plot.	Top-dressing.	1922.	1923.	Total.
		Tons cwt.	Tons cwt.	Tons cwt.
1	Super, 2 cwt.	9 0	5 7	14 7
2	Control (no manure)	7 14	4 17	12 11
3	Super, 2 cwt.	9 0	5 2	14 2
4	Super, 2 cwt., 1921 and 1923	8 7	6 6	14 13
5	Nauru phosphate, 2 cwt.	7 11	5 15	13 6
6	Control (no manure)	7 14	5 6	13 0
7	Nauru phosphate	7 11	5 9	13 0

It will be noticed that the super plots gave an average of 1 ton per acre over the Nauru phosphate, and the superiority of the super could be seen throughout the year. A further area of 13½ acres has been sown in temporary pasture, and this will be used for top-dressing experiments during the 1924-25 season.

LUCERNE.

The lucerne was again cut three times, a fourth cut being wasted owing to bad weather. As shown in the next table, this stand continues to give satisfactory results, particularly in view of the fact that the Marton Area is not considered suitable for lucerne, and that owing to the stiff nature of the land it has not been possible to cultivate the stand during the past four years.

Season.	Sown broad-cast.	Sown in 7 in. Drills.	Sown in 14 in. Drills.	Sown in 21 in. Drills.
	Tons cwt.	Tons cwt.	Tons cwt.	Tons cwt.
1920-21 (three cuts)	17 0	17 5	17 0	14 14
1921-22 (four cuts)	25 10	19 14	22 12	21 8
1922-23 (three cuts)	18 15	17 13	18 4	16 12
1923-24 (three cuts)	15 15	14 17	14 4	13 6
Average for four seasons ..	19 5	17 7	18 0	16 10

A small area of lucerne sown in 1919 in this field was divided, and one-half top-dressed with super at the rate of 2 cwt. per acre, the other half being left as a control. Subsequent cuttings gave a return of 1 ton 18 cwt. from the manured area and 19 cwt. from the unmanured area.

GENERAL.

In addition to producing the above-recorded crops, plus 14 tons of pressed hay, the whole experimental area carried an average of 1·78 sheep per acre for the year, and would easily have carried three per acre had the sheep been available when required.

VARIATIONS IN THE PERCENTAGE OF BUTTERFAT IN MILK.

A STUDY BASED ON NEW ZEALAND C.O.R. DATA.

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THE percentage butterfat content of milk, more commonly known as the "test" or "milk-test," is a very useful number to dairymen. It supplies the key to the total amount of butterfat contained in milk, provided, of course, that the weight of milk is known. With the aid of modern testing-appliances the butterfat test of milk is such a simple operation, and the system so reliable, that the work can well be done by the farmer himself or even by school-children. The dairy-farmer who owns a testing outfit, and who uses it regularly, is supplying himself with valuable information. Not only is he recording the production of his cows, but also he is educating himself in regard to the better understanding of the peculiarities of each cow and the better management of the herd, besides acquiring important knowledge necessary to good breeding-practice. Most dairy-factory concerns pay the supplier on the basis of the butterfat content of milk, and for that reason the test is always of much concern to the factory supplier. In the supply of milk for human consumption the producer is rarely paid for quality, and his chief concern is maximum production of milk, provided the percentage of butterfat content does not fall below the minimum required by the law. But even in this branch of the dairy industry there seems to be a tendency to payment on the quality basis of milk, and, if this were to become popular, dairymen would require to use tests more than previously. It will thus be seen that the butterfat percentage of milk is an essential factor in practically all branches of the dairy industry.

I. GENERAL VARIATIONS.

BREED AND INDIVIDUALITY OF COWS WITHIN EACH BREED.

It is a well-known fact that the average percentage of butterfat in milk varies with the breed of cattle, but can it be said that the test is constant for each breed? It is possible that the average tests of a breed may vary with the country of location, with the particular type bred for in a country, and with the climate. Unfortunately, the average tests for the various dairy breeds in other countries are rarely published, and thus, through lack of data, it is difficult to investigate these points. From what is known, however, it appears that the average test for each breed varies very little for different countries, and that the test is fairly constant for each breed. It is thought quite likely that small differences would show themselves if the same breed were bred for quality of production in one country and quantity of production in another. Differences in climatic conditions would hardly show any effect, because almost all dairy cattle are protected from extremes of temperature when necessary, and receive attention accordingly.

The average tests obtained in New Zealand from all the first-class certificates of record of the various breeds from 1913 up to 31st December, 1923, are as follows:—

Table 1.

Breed.					Average Test.	Number of Records.
Jersey	..	..	..	..	5.55	2,391
Red Poll	..	..	..	..	4.39	34
Ayrshire	..	..	..	..	4.11	113
Milking Shorthorn	..	..	..	..	3.97	263
Shorthorn	..	..	..	..	3.90	6
Friesian	..	..	..	..	3.54	1,042

The difference in the average tests of the Jersey and Friesian breeds is quite marked, while for the other four breeds the differences are smaller. If more breeds were represented it would probably be found that no two breeds test quite the same.

The reason that the average tests are constant within small limits for each breed is no doubt due to heredity, since it seems to be well recognized that the quality of milk is hereditary; but when one comes to study the yearly tests of individuals within a breed, it is found these vary widely, as the following tabulation of our C.O.R. data will show:—

Table 2.

Breed.					Average Yearly Test.	Highest Yearly Test.	Lowest Yearly Test.
Jersey	..	..	..	..	5.55	7.65	3.85
Ayrshire	..	..	..	..	4.11	5.25	3.29
Milking Shorthorn	..	..	..	..	3.97	5.60	3.16
Friesian	..	..	..	..	3.54	4.89	2.74

The highest Jersey and the lowest Friesian tests of these averages could hardly be reconciled as belonging to cows of the other two breeds, but the lowest Jersey and the highest Friesian tests could each be credited as belonging to an Ayrshire or to a Shorthorn. The highest Ayrshire and Shorthorn tests could be mistaken for Jersey tests, and the lowest Ayrshire, Jersey, and Shorthorn tests for Friesian tests. From this it is patent that variation due to individuality is considerable, and that it would be a difficult matter to name the breed of cow for some individual tests. In order to compare the range of variation of tests for the four chief breeds the following table has been prepared:—

Table 3.

Breed.					Percentage of Highest Test above Average Test.	Percentage of Lowest Test below Average Test.	Percentage Total Range of Variation.
Milking Shorthorn	..	..	..	..	41	20	61
Friesian	..	..	..	..	38	23	61
Ayrshire	..	..	..	..	28	20	48
Jersey	..	..	..	..	38	31	68

Thus it is seen that the average total range of variation is about 60 per cent. of the average test for a breed.

Seeing that the tests within a breed vary so much, the breeder is afforded good scope to breed for quality by selection. In order to present at a glance over what range yearly tests vary within each breed the accompanying graphs were prepared. They clearly indicate how wide this variation is, the variations being mainly due, of course, to the individuality of the cow. It is interesting to note that the test corresponding with the largest group does not coincide with the average test for the breed. Nevertheless it will be observed that the average test lies about midway among the largest groups. In the case of the Milking Shorthorns the maximum group is the one which lies between 3.8 and 3.89, while the average tests of the breed lies in the next group, 3.9-3.99. Seventy-eight per cent. of the Milking Shorthorn tests lie between 3.5 and 4.29. The biggest groups in the Ayrshires are those of 4.0-4.09, 3.9-3.99, and 3.8-3.89, each having thirteen tests. The average test of the breed lies between 4.1 and 4.19, this being the next largest group, with twelve tests. Seventy-six per cent. of the Ayrshire tests lie between 3.5 and 4.29. It is remarkable that the percentages quoted above for the Milking Shorthorns and Ayrshires, and for the same limits, should be almost identical, although there is a difference in the average tests of 0.14. The average test of the Friesian breed is 3.54, while the largest group is one lower than this—namely, 3.4-3.49. Seventy-seven per cent. of the Friesian tests are between 3.1 and 3.89. Here again it is seen that the percentage is practically the same as with the other two breeds, the range of the limits being 0.8, as in the other cases.

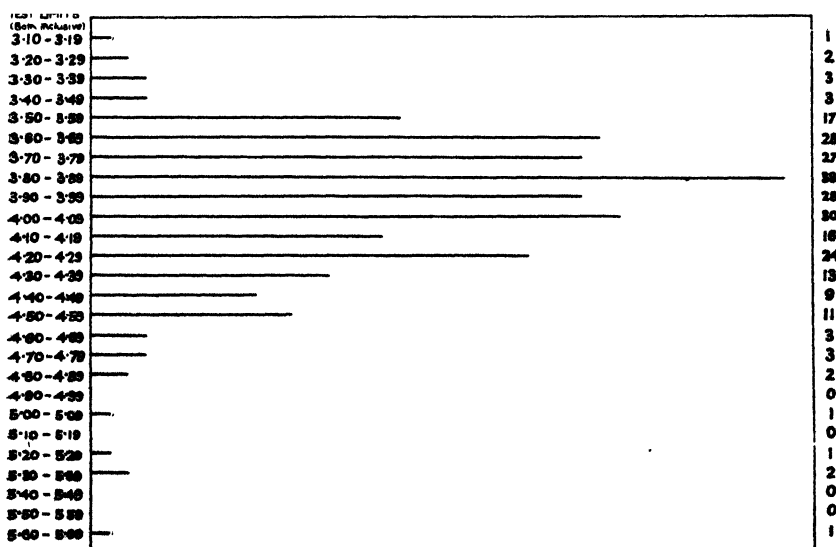


FIG. 1. SHOWING GRAPHICALLY THE RESULT OF ANALYSIS OF ALL YEARLY TESTS OF MILKING SHORTHORN COWS UNDER THE NEW ZEALAND C.O.R. SYSTEM.

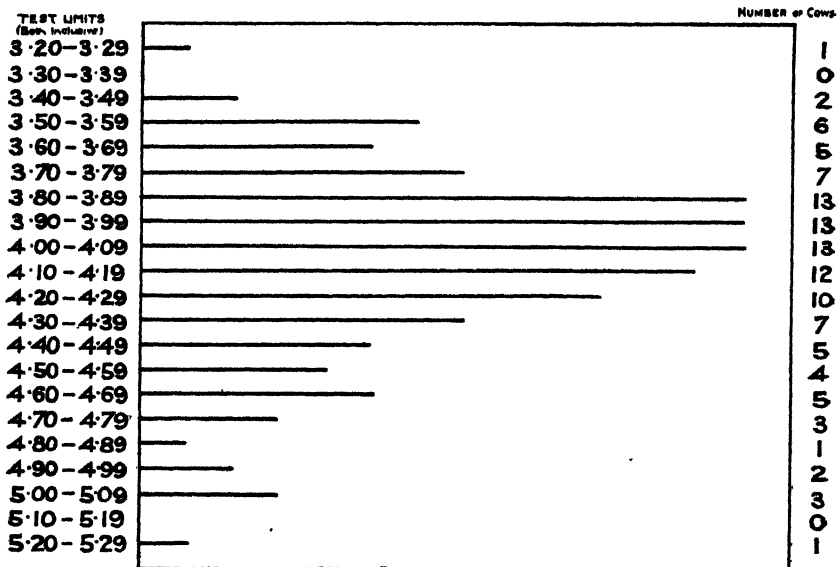


FIG. 2. ANALYSIS OF ALL YEARLY TESTS OF AYRSHIRE COWS.

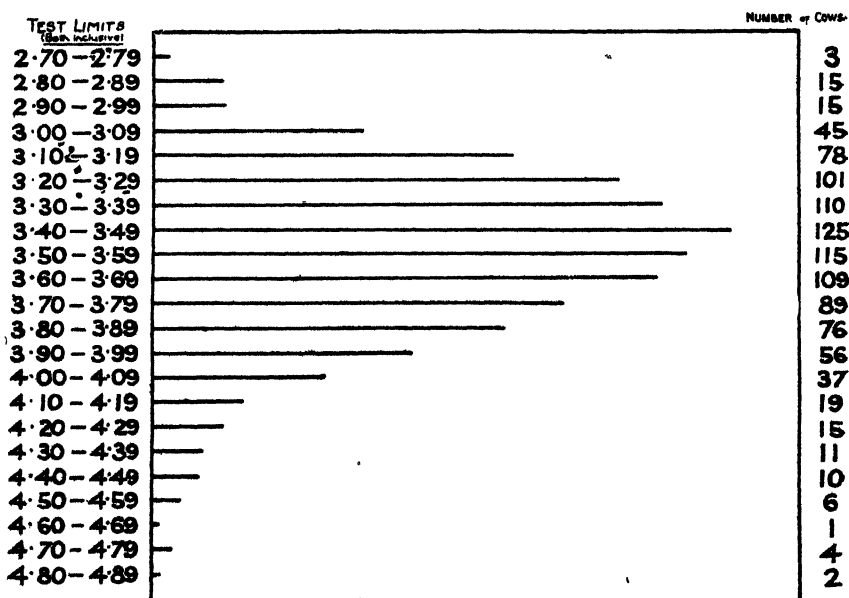


FIG. 3. ANALYSIS OF ALL YEARLY TESTS OF FRIESIAN COWS

RELATION OF QUANTITY AND QUALITY OF MILK.

When a breeder breeds to raise the test, does he attain quality at a sacrifice to quantity of milk-production? This is a question of vital importance to breeders, and to investigate the point it must not be overlooked that in analysing data to probe the problem only records for cows of the one breed and age should be compared. The two largest groups available are the two-year-olds of the Jersey and the Friesian breeds, and the tests have been analysed as in the three preceding graphs, and these subdivided again according to the quantity of the milk-production. The following two tables show the results obtained:—

Table 4.—Analysis of Two-year-old Friesian Tests according to Quantity of Milk-production.

Milk-production.	Percentage of Tests below 3'4.	Percentage of Tests 3'8 and above.	Average Test.	Number of Tests
lb.				
6,000	0	63	3'96	16
7,000	3	45	3'77	33
8,000	21	19	3'62	53
9,000	29	30	3'62	56
10,000	36	25	3'55	53
11,000	36	23	3'52	53
12,000	33	15	3'55	40
13,000	40	14	3'46	42
14,000	33	19	3'54	21
15,000	35	24	3'59	17
16,000	69	6	3'28	16
17,000 and over	38	8	3'48	13

Table 5.—Analysis of Two-year-old Jersey Tests according to Quantity of Milk-production.

Milk-production.	Percentage of Tests below 5'0.	Percentage of Tests 6'0 and above.	Average Test.	Number of Tests.
lb.				
3,000	0	100	6'64	9
4,000	3	31	5'82	103
5,000	11	27	5'64	280
6,000	15	24	5'59	274
7,000	11	23	5'63	246
8,000	24	19	5'53	140
9,000 and over	23	13	5'42	102

Although the variations for the second and third columns of these tables do not progress quite uniformly in the lower half of each table, especially for the Friesians, it will be noticed that the higher the milk-production groups are taken the more the percentage of low tests increases and of high tests decreases. This seems to indicate that the quality of milk is raised at the expense of quantity. When the average tests are taken group by group it is found that for the first few groups the test does decrease uniformly, but for subsequent groups does not appreciably vary. Of course, it must be borne in mind that all cows were not under the same conditions in regard to quantity and variety of feed, and general care and treatment. It is a well-known fact that if a cow

is neglected late in her lactation period, or is due to calve early, she will soon dry off, and that the tests rise more or less steeply according to the rapidity of decrease in milk-flow. In other cases where a cow's milk-production is kept up as much as possible to the close of her lactation period, or she is due to calve late, the test does not rise as rapidly. Such cases affect the average yearly test, and the following table bears this out to a certain extent :—

Table 6.—Comparison of the Highest- and Lowest-testing Two-year-olds of the Four Principal Breeds.

Extreme Groups.	Average Number of Days in Milk.	Average Number of Days Empty after Commencement of Test.	Average Number of Days between Calvings.	Average Production of Milk.	Average Production of Butterfat.	Average Test for Lactation Period.
Six highest-testing two-year-old Friesians	343	107	386	lb. 8,792·0	lb. 400·02	4·62
Six lowest-testing two-year-old Friesians	337	123	407	12,695·4	360·13	2·84
Six highest-testing two-year-old Ayrshires	331	83	367	7,053·2	331·33	4·70
Six lowest-testing two-year-old Ayrshires	345	114	397	10,826·4	395·33	3·65
Six highest-testing two-year-old Milking Shorthorns	353	115	395	6,968·1	321·15	4·61
Six lowest-testing two-year-old Milking Shorthorns	355	133	411	10,083·0	364·28	3·61
Six highest-testing two-year-old Jerseys	358	118	402	6,200·9	450·40	7·26
Six lowest-testing two-year-old Jerseys	349	107	388	7,034·3	297·97	4·24

It will be readily noticed that the two-year-old Jersey extreme groups bear out the direct opposite to those of the three other breeds. This may be only a phenomenon occasionally met with in statistics. However, the reason appears to be due to the closeness of equality of the average milk-production, for it will be noticed that for each of the others there is a considerable difference in the average milk-production of the two extremes. The extremes were chosen for the reason that there are so many variables which obscure one another, and it is only when the extremes are compared that the effects of the several variables are better apparent. Apart from heredity, the chief factors which appear to influence the test are the number of days in milk, the number of days empty, and the number of days between calving at commencement of test and subsequent calving. Besides these, the age, time of calving at commencement of test, kind of season experienced, feed, and treatment are all factors which influence the test to some extent. As some of the factors are interdependent, the problem is very complex, and presents many difficulties to the investigator. The number of days in milk does not always tend to influence the test in the one way, for in some cases the owner, for reasons best known to himself, terminates a test before a cow is actually dry, although she might reasonably have continued in milk for perhaps two more months. In such

cases the average yearly test will be lower than normal, for the reason that the higher final monthly tests were not included.

To revert back to Tables 4 and 5, it must be conceded that the largest number of cows represented doubtless received average treatment, and calved about the end of the thirteenth month after test, and thus should have tested normally. It is reasonable to expect all cases to be represented in each group with the exception of the extreme groups. This, then, seems to explain the marked decrease in the tests for the first three groups, but, at the same time, the explanation does not appear to apply so well to the last few groups. The average tests of all two-year-old Friesians and Jerseys are respectively 3.56 and 5.6. Thus it is found that the last eight Friesian groups, except that for 15,000 lb. milk, are below the average, and that the first four are above the average. In the case of the Jerseys, the tests for the first three groups are above, and the last two below, the average. The Jersey tests for groups 9,000, 10,000, 11,000, and 12,000 (not given in the table) are 5.41, 5.46, 5.47, and 5.08 respectively, and thus are below the average test for all two-year-olds. Taking the middle groups in each table—they being the largest numerically—and remembering that these probably represent cows under average conditions, it cannot be said that the test has been materially lowered for higher milk-production.

From this it may be accepted that quality and quantity of milk are independent factors, and that they are separately heritable. There also seems good reason to believe that the average test for the year is slightly influenced according to the extent to which the milk-production for the year may vary from normal. Combining the two, it seems that a cow inherits capacity for a certain quality and quantity of milk, but that the two may vary during a lactation period according to circumstances.

By selecting good producing animals of high test for breeding purposes the average test as well as the milk-production of a herd may be raised, and it is this which most breeders recognize as their goal.

(To be continued.)

Fowls poisoned by Boxthorn.—The Department's Chemist reports an uncommon case of a number of fowls being fatally poisoned by the leaves of the African boxthorn (*Lycium* sp.) at Wanganui last year. The fowls were confined in a bare run, but got access to the leaves of the shrub through the fence, and ate them as far up as they could reach. The identification of a couple of leaves of this plant in the crop of a fowl led to the detection of the cause of mortality.

Farm-dairy Instruction.—In his annual report for 1923-24 the Director of the Dairy Division remarks: "The work of instruction respecting the milking and care of milk and cream on the dairy farm appears to be growing in popularity. The tendency for dairy-farmers to regard the Farm-dairy Instructor as a friend and helper, rather than as an inspector, is growing to such an extent that dairy-farmers now frequently send for the officer. The farm-dairy instruction work in conjunction with the efficient grading of cream and milk, with differential payments according to quality, is a very effective combination in the interests of improved quality of milk and cream. I expect the farm-dairy instruction work will, if given the necessary encouragement, become general throughout New Zealand."

HANDLING THE WOOL-CLIP FOR SALE.

SHEARING-TIME PRACTICE ON THE FARM.

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THE subdivision of large sheep-stations in New Zealand in earlier years was followed by considerable retrogression as regards trueness to type in sheep, together with less evenness and character in the wool. This was largely owing to a lack of knowledge of sheep-breeding and wool-growing on the part of the smaller settlers. Moreover, large numbers of farmers came to consider that it did not pay to have their wool skirted and classed, with the result that a great proportion of the Dominion's clip reached the market almost in the condition in which it came off the shearing-board. It is encouraging to note, however, that of late much of this lost ground has been recovered. Publicity, lectures, and demonstrations provided by the Department of Agriculture may fairly be claimed to have had a marked effect in this direction. The shearing season of 1923-24 made a record as regards the number of wool-producers who had their clips properly prepared before sale—with handsome ultimate profit to themselves. There is still much to be done, however, and we should not be satisfied until all the fleece-wool shorn in the Dominion is properly skirted and classed. Farmers may (1) do this work themselves, (2) employ a wool-classer, or (3) let their wool-broking firm do it for them. The present article aims at helping the producer to take the first course and become self-reliant in this respect.

THE WOOL-SHED.

The wool-shed should be thoroughly cleaned out a day or two before shearing commences—not merely swept by a broom, but washed out with water and disinfectant. Particular attention should be paid to the parts of the shed the wool actually comes into contact with. On no account must twine, chaff, or rubbish of any kind be left in the wool-bins, wool-press, wool-room, or on the shearing-board; unless removed such substances are likely to get into the wool and depreciate its value when offered for sale. Sheep-skins should also be kept out of the shed during the shearing-period.

It is essential that there should be a good number of windows or skylights in the wool-shed, so as to admit plenty of light. This applies very strongly to the wool-tables, as it is of urgent necessity that there should be ample light at this part of the shed to enable those who are skirting, lapping, rolling, and classing the wool to do their work comfortably, expeditiously, and without error. In a large number of wool-sheds the light is very poor. Windows by the wool-table should be just about the length of the table.

TABLES AND BINS.

A suitable size of wool-table is 9 ft. long and 4 ft. wide. It will be found very convenient to have the table canted—that is, one side higher than the other—and the higher side against the wall of the shed. The lower side is where the wool-roller is working from, and

when he has done the work on the side of the fleece nearest him he simply reaches across the table and brings the far side of the fleece over to him. Having the table at an angle makes this easier than if the table was level. One often finds the tables made too small, with the result that the fleeces cannot be thrown out straight, which makes good work at the table very difficult, some of the skirtings being apt to be left on the fleece. When the table is a good length and width this greatly facilitates the work of dealing with the wool, more especially if a fast gang of men is on the shearing-board.

It is very handy to have a small table for putting the locks over. A size of 3 ft. 6 in. each way will do. Put $\frac{1}{2}$ -in.-mesh wire netting over the top of the frame, then nail a board on each side and allow the top edge of the boards to come 4 in. above the wire netting. When the locks are placed on the table and shaken the rubbish falls through the netting, and dags and large pieces of wool can be readily picked out and each lot put in its place.

A very convenient size for the wool-bins (fleece and pieces) is 3 ft. wide, 4 ft. 6 in. to 5 ft. deep, and 7 ft. high, which will hold about one and a quarter bales of wool. The width will allow three large fleeces in each row, or, when the fleeces are smaller, four will go in each row nicely for handling when pressing. Pieces or belly-wool can be thrown into their respective bins and tramped occasionally, but each class must be kept in separate bins.

THE FLEECE-PICKER'S DUTIES.

After having shorn the belly-wool off the sheep the shearer should detach it from the fleece and throw it back on the shearing-board convenient for the fleece-picker to pick it up and examine it. If off male sheep the centre will be found stained with urine, and this part must be taken out at once by hand and put into a basket or sack. It is convenient for this purpose to have a sack hung in the corner of the catching-pen, with the mouth of the sack open. These stained pieces must be dried outside in the open air before being pressed. After detaching the stained piece from the belly-wool the latter should be thrown into a bin allotted for that class.

When the shearer has finished shearing the sheep and let it go it will be found in nearly every case that the length of the fleece is lying across the shearing-board, the neck part being nearest the catching-pen wall and the hind quarters nearest the counting-out pen door. The fleece-picker will with his feet push the neck towards the britch of the fleece until he is in a convenient position, when, bending down and reaching forward at the same time, with his hands he catches hold of a hind quarter in each hand; then by making a half-circular movement with his hands away from each other he gathers the rest of the fleece between his hands, picking the fleece up and carrying it to the wool-table. Arriving there he turns the back of his hands upwards, and, making a throwing-forward movement, he releases the part of the fleece which he has between his hands, but retains hold of the part which he has in each hand. In this manner the fleece is thrown nice and straight on the table for the wool-rollers.

The fleece-picker will then return up the board and sweep the part of the floor from whence he removed the fleece, as there are always a

few trimmings and second cuts to be removed before the shearer brings out another sheep from the catching-pen. In sheds where there is a large number of shearers the fleece-picker will find it convenient to pick the fleece up in the manner just described, put it down against the catching-pen wall, get hold of the broom, and sweep the stand clean. Having done this, he can then carry the fleece to the wool-table, and throw it in the manner previously described. He should see that his board is kept clean, taking all large pieces of wool or dags out of the sweepings and putting each class into the place allotted for it.

The fleece-picker will also put Stockholm tar or sulphur (whichever is provided for the purpose by the owner of the shed) on any cut on the sheep when the shearer calls for it. On no account is coal-tar to be used, as it goes hard, and will not scour out when the wool is being scoured; it also damages the machines in the woollen-mills if it has not been taken out beforehand.

Black fleeces should not be thrown upon the wool-table. Before the shearer brings a black sheep upon the board his stand must be swept clean of all white wool, and in shearing the animal he should leave the belly-wool attached to the fleece. As soon as the sheep is shorn the fleece-picker should roll up the fleece with all the locks and belly-wool, and put it away where it will not come in contact with the white wool. The board should also be swept again.

SKIRTING, LAPPING, AND ROLLING.

As soon as the fleece is thrown out on the table it is ready to be skirted. This is the critical stage of preparation for market when sold in the grease. Skirting consists in removing by hand from the fleece any outer edges which do not harmonize with the rest of the fleece. The following method is recommended: Starting at the britch, remove any part which is stained either by excreta or urine, going right across this part of the fleece. In some fleeces (mostly in crossbred flocks) the lower parts of the britch are inclined to run somewhat hairy, more especially down to the hind legs—the cause usually being carelessness in breeding. This hairy piece should be removed and put in with the pieces. Having detached these parts, throw them into a basket, which should be handy to the table for that purpose. Then work along the side of the fleece nearest, removing any dirty pieces with the one hand, and as you skirt this side turn the fleece in one-third its own width with the other hand. Now you come up to the arm-pit of the fleece, and this part should be watched carefully, as it is just here that the skirtings are the dirtiest, this being partly due to the action of the fore leg, and to the sheep when lying down always having this part in direct contact with the earth. Another cause is the action of the heart generating increased heat and perspiration in that part of the body. Now pass along up to the neck and cheek pieces, which must be removed. As a rule one finds that this wool is inclined to be somewhat knobby or clubby at the tip, and it should be kept separate from the skirtings along the sides of the fleece. Now turn the neck part of the fleece back slightly towards the shoulders, and look back on the side you have skirted and turned in. The shorn side being up, one

can see if any skirtings have been missed ; if so, remove them at once. Then reach across the table with both hands, catch hold of the far side of the fleece, and bring it towards you until that edge rests flush with the side nearest you. This way of bringing it over brings the shorn side uppermost. Now go down the last side of the fleece, removing any dirty skirtings ; with the shorn side turned up, one can see at a glance what to take off. Working back from the neck of the fleece to the britch, throw the skirtings into the bin allotted for them, and the fleece, being properly skirted and lapped, is now ready for rolling. Turn the britch in and roll right from it straight out to the other end of the fleece. Fleeces done up in this way do not need tying of any description. This is the simplest, easiest, and quickest way of skirting, lapping, and rolling ; the operator can always see over his work and rectify any errors when skirting, and the fleeces are readily handled afterwards. Do not adopt the practice of rolling the fleece from both ends. Such fleeces when being handled come loose, both ends bulge out, and rolling again is necessitated. Besides, there is always a loss of time when rolling at the table.

Carrying out the practice described, the following lines, which have been removed from the fleece-wool, will result : (1) A pieces—the skirtings taken off on each side of the fleece ; (2) neck-pieces ; (3) stained pieces—wool stained either by excreta or urine ; (4) belly-wool ; (5) locks—the sweepings of the board and small pieces which fall under the wool-table.

In the case of seediness in the wool, if a fleece is only seedy on the outer edges, take off the seedy parts first, putting such pieces into their respective bins. The fleece, then being clean, can be lapped, rolled, and classed into whichever line it harmonizes with. If a fleece is seedy all over, skirt it ; then, after lapping and rolling, class it into the seedy-fleece bin. Wool is termed “seedy” when it is carrying any seed of piripiri (hutiwai), horehound, burr clover, or Bathurst burr, the first-named being the most common and the only really troublesome one in this country.

CLASSING.

In no other work is one more called upon to adapt oneself to circumstances than in wool-classing—according to the clip being handled. Clips vary in every district, but the following notes will be found useful in connection with the classing of fleece-wool :—

“Combing” is a term applied to any wool in which the fibre is long and strong enough to stand the tension of the combing-machine. The best way to test the wool is to take a staple between the thumb and finger of each hand and then draw the staple out tight. If it will stand this tension all such wool can be classed under “combing.”

“Clothing” is a term applied to any wool in which the fibre, although long, is tender (has a break in it), or any wool which is too short in length of fibre to be combed. In respect to the tender wool, the break is due mainly to either shortage of feed or disease. If feed-shortage is the cause, then in a small flock the break will be apparent right through the clip ; on a large station it will be apparent in sheep which have been running on the block of country where there has been a decided shortage. When the break occurs in odd

fleeces throughout the clip, it denotes that these sheep have suffered from some disease during the year, at which time the animals will have been off their feed. As regards wool which is too short for combing purposes, this mostly comes off old merino sheep, generally ewes, more especially those running on high, rough country. As a result of the heavy losses which occasionally occur on such country from severe winter conditions, every ewe has to be kept for breeding-up purposes—hence the short wool produced. One is able to tell from the fibre at which period of the year the check in the wool took place. If it was in the autumn the break will be found nearer the tip of the fibre; if during the winter the check shows about half-way down the fibre; if in the spring it is nearer the lower end of the fibre.

“A (or first) combing”: This grade comprises the finest, brightest, and cleanest combing-fleeces in the clip. The line should be made broad enough to take in the greater part of the combing-wool.

“B (or second) combing”: This takes in the coarser combing-fleeces, heavier in condition and duller-looking than the first combing.

“C combing”: This grade applies to a merino clip in which are found a number of fleeces of very fine wool, but having that heavy greasy tip on it. This wool is best kept by itself, as when scoured properly it will realize the same money as the A combing does when scoured; but, owing to the big percentage of loss in scouring, the buyer will not give so much for it in the grease as he does for the A combing.

“Clothing”: Fleeces which are clean, but either too short or too tender for combing purposes.

“Dingy”: This term covers any fleeces which have been discoloured either by climatic conditions, log-stain, or parasitic pests.

“Sandy”: This term covers any fleeces which have sand throughout them. As the sand absorbs the yolk (which is the life of the fibre) instead of the wool doing so, this wool is always found to be tender. It is mostly found on sheep running on very high country.

“Cotted” or “matted”: A very wet winter increases the tendency of the wool to be cotted or matted. Another cause is old age. A broken-mouthed ewe may be in lamb, and from within six weeks of and up to lambing-time, owing to the state of her teeth, she is unable to fully supply the demand made upon her both by the undropped lamb and the fleece. It is then that the coting commences. Ill health is another cause contributing to cotted fleece. These fleeces should be put in a bin by themselves.

“Double fleece”: This means any fleeces which have not been shorn for two years or over. In such fleeces only the stained part across the britch should be removed.

“Black fleece”: As previously mentioned, this should not be thrown on the table, and must be kept away from the white wool.

MIXED FLOCKS.

Three leading examples of mixed flocks may be given. The first is fairly typical of New Zealand conditions, being a mixed flock of about three thousand sheep, all carrying clean, strong, shafty wool, and consisting of half-breds, three-quarter-breds, crossbreds, and merinos. The majority being half-breds, two classes should be made of that fleece-wool. Into the first wool-bin put the finest and best fleeces, and

after it is pressed brand the bale "A Combing Half-bred." Into the second bin place the coarser and heavier-conditioned fleeces, branding the bale "B Combing Half-bred." Into the third bin put the finest and best of the three-quarter-bred fleeces, branding the bale "A Combing Three-quarter-bred." Into the fourth bin can be placed the coarsest of the three-quarter-bred and the crossbred fleeces, as it will be found they are of about the same spinning-quality; and as there will be only one line of this, brand the bale "Crossbred Combing." The fifth bin will be used for the merino fleeces, and the bale branded "Merino Combing," there being only one line.

Another example, and one that is very common, is Lincoln, Lincoln cross, Romney, and Southdown. There is a wide difference in the spinning-qualities of these wools, ranging from Lincoln (34's to 36's), Lincoln cross (40's), Romney (44's to 46's), and Southdown (54's to 56's), and each of these lines must be kept separate. If there are only a small number of Southdowns it will be to the grower's advantage to let the broker bin them with other Southdown wool.

The third example will be a flock comprising Romney, Romney crossbreds, and Lincoln crossbreds. Here we have three distinct lines, and they must be kept separate from each other. These sheep as a rule grow strong shafty combing-wool, and if the lines are in equal proportion the following should be made: "A combing," which takes in all the finest-fibred and best-conditioned fleeces in the Romney wool; "A combing" in the Romney cross, this also taking in all the coarser fleeces of the Romney; "B line," Romney cross; "A line," Lincoln cross. Any discoloured fleeces in each of these lines can be put into one line; they can be binned at the wool-store. Any cotted fleeces can also be made into one line and similarly binned. If there is only a small clip like the foregoing, then just make three lines, marking them "A Romney," "A Romney cross," and "A Lincoln cross."

Farmers could save a great deal of this cutting-up if they would breed and keep to only one or two lines, thus reducing the number of classes to a minimum and enabling the clip to be put up in larger lines.

Sometimes a grower is puzzled as to why his clothing-wool realizes almost as much as his combing-wool. The cause is that each wool has its own individual buyers. The worsted-manufacturer requires a wool with strength and character—strong so that it will comb, and character to give it elasticity; therefore any weak tender-fibred wool is of no use to him. Another manufacturer may not be so particular, as he can work up any wool which comes under the term of "clothing."

DINGY CLIPS.

In some seasons the whole clip is dingy, and if there is only one line of sheep on the farm two classes should be made of the fleece-wool. One class will embody all the strong fleeces which will stand the tension of the combing-machine; the other class will take in all the weak tender fleeces. Enter the former line as "Dingy combing," and the latter as "Dingy clothing." If the flock is a mixed one and all dingy, keep each line separate from the others and enter it according to whichever it belongs, as follows: "Half-bred dingy," "Crossbred dingy," "Merino dingy," and other lines in the same way.

SEEDY CLIPS.

Sometimes the whole clip is seedy, and if there is only one breed of sheep on the place two classes should be made, one containing the fleeces which are slightly seedy and the other those which are carrying the most seed. The former should be entered in the wool-book as "Slightly seedy," and the latter "Very seedy." In the event of the flock being a mixed one and all the wool seedy, keep each line separate from the others and enter it according to whichever line it belongs, such as "Seedy Romney Marsh," "Seedy Romney cross," "Seedy Lincoln cross," "Seedy Merino," and so on.

On no consideration should seedy wool be packed with clean wool. All lots must be kept separate if full value is to be received for clean lines. "Seedy fleece," "Seedy pieces," "Seedy belly-wool," "Seedy locks," "Seedy stained pieces," respectively, is the best way to mark each line which is carrying seed. Enter it thus in the wool-book; then there is no chance of it being put up for sale with the clean wool and interfering with the prices the latter will realize.

LAMBS' WOOL.

The difficulty usually experienced by the fleece-picker in "gathering" lambs' wool on the shearing-board can be overcome by using a simple contrivance made with two pieces of 4 in. by 1 in. boarding, each 2 ft. long. Having planed all sides to make them smooth, the two boards or battens are connected by tacking on at one end of each a piece of canvas or sacking 18 in. long and 4 in. wide. When the lamb is shorn and the wool is on the floor the fleece-picker takes the free end of each board in each hand, spreads the boards apart so as to allow them to come on the outside of the wool, then closes the boards towards each other. This quickly gathers the wool between the boards and canvas, and it can then easily be carried away and tossed on the wool table.

Previous to putting lambs' wool on the table the latter should be covered with a piece of hessian or sacking in order to prevent locks going through. When the wool is put on top of this it can be quickly sorted into its different lots. All the best even-quality, clean, well-grown wool should be put into the first or A grade. Any very short, slightly discoloured wool or trimmings from low down on the legs go into the second or B grade. Any wool stained either by excreta or urine should be put into the third line, marking it "Stained pieces." When sorting according to spinning-quality it is necessary to keep each of the following as separate lines: 36's, 40's, 46's, 50's, and 56's. Very little of the two latter counts are shorn as lambs, the majority being from 40's to 46's (mostly Romney or Romney cross). Too many lines should not be made, but Lincoln or Lincoln crossbred must be kept separate from any other better-quality wool. Too often all these wools are found mixed together; this is an unwise proceeding, as the producer does not receive the best price for his best wool, which he would have done had the different qualities been kept separate.

Lambs' wool frequently carries seed, and the procedure detailed under the heading of "Seedy Clips" should be carefully followed in such case.

PRESSING.

The presser should see that his press is in order, and that the caps and woolpacks before being used are put out in the sun, this making the sewing of the bale easier. When putting fleeces into the bale it will be found that three large fleeces will fit in each row, and that two rows are required to fill the square of the press. This is the best method, as in the first place it gives the presser a firmer surface to tramp down, and the wool does not spring up as it does when it is just bundled in. Further, the weight is got in easier, and the wool is well shown in layers of six when the bale is opened for sampling. If the fleeces are very large only five can be put in each layer. In such a case place the first fleece each time in the centre of the bale, then pack the other four round this one. When tramping the fleeces in the press, tramp them hard down each side. This method causes the fleeces to jam together in the centre of the layer and prevents the wool from springing up.

If a farmer has only enough fleeces to make a light-weight bale he should skirt the fleeces and, when classing them, make two lines. Put all the finer-fibre fleeces into one bin and the coarser-fibre fleeces into another bin. When pressing, put the coarse fleeces at the bottom of the bale, then place a piece of bagging on top of them. Next put in the fine-fibre fleeces, and sew the cap on the bale. When branding the bale, make a black line round two sides of the bale at the point where the division comes between the two wools.

SEWING ON THE CAP.

The easiest and best method of sewing the cap to the bale is to start at one of the corners. Drive the needle through the cap first, and then draw the twine through up to the knot. Bring the needle down and drive it through on the right-hand piece of the corner of the bale, then up through the cap again, and down into the bale about the same place. With the twine draw the cap and bale together tight, then drive the needle through from the sewn corner to the loose left-hand piece of the corner of the bale. Put the stitch across this corner and pull tight. This draws the corner together and saves the big open corners which otherwise have to be sewn after the bale is tumbled out of the press.

When sewing the cap and bale together, drive the needle in a slanting upward direction from right to left through the cap, and then drive it into the bale just opposite where it came through the cap. This method makes a short, neat, regular stitch on the outside of the bale, and makes the latter look neater than is the case if the stitches are long and irregular. Further—and this is very important—the short, neat, regular stitch adds to the strength of the pack when the bale is being handled afterwards.

WEIGHING, BRANDING, AND BOOKING.

After pressing comes weighing, branding, and entering the description of the wool in the bale in the wool-book. The bale should be branded on the cap end with the station or farm name and the number; then the same done on one side, also branding on the class of wool in

the bale. Say it is A combing, Romney Marsh hogget : the letters A over RM over H will do ; or if it is wethers, W will suffice. If scales are available it is best to have the bale weighed.

The proper stencilling cake or powder should be used for branding. If a cake, knock off about one-quarter and break this into small pieces ; put these into a tin receptacle and pour in boiling water, which will dissolve the pieces quickly. When cool pour into a bottle, cork, and use the liquid as required, diluted with cold water if too thick. Into an enamel or tin plate put a small piece of wool ; pour some of the liquid on this, and when branding the bale dip the brush into the plate (this ensures an even supply of the fluid) and rub the brush over the stencil-plate. If a station or farm has a private mark put this on the bale first ; the name of the station next in the middle ; then the number of the bale underneath.

All bales as soon as they are branded and weighed should be duly entered in the wool-book, with the number of bale in left-hand column, description of wool in the bale in the wide column, and the weight in the three columns on the right. When sending the wool to market an invoice copied from the wool-book should be sent to the selling firm.

GROUPING AND BINNING.

A great advantage to wool-growers, particularly the man with only a small number of sheep, are the "grouping" and "binning" systems. The term "grouping" is applied to any number of bales of wool which have been put together as one line for sale by the wool-broker. For example, a farmer may have one or two bales of fine fleece-wool, which he marks "A," or "1st" ; the same number of bales of coarser wool, which he marks "B," or "2nd" ; one bale of dingy ; and one bale each of pieces, belly-wool, stained pieces, and locks. When these bales reach the wool-store they are opened by the broker, who then groups them with other bales of the same quality and giving the same clean yield.

"Binning" is a term applied to any wool which has been sent in by the grower for his broker to either skirt and class or class only. In the latter case the skirting would have been done in the shearing-shed. When this wool arrives at the store the fleeces are taken out, then skirted and classed in the bins according to quality, condition, strength, colour, and yield. If the skirting has been done in the shearing-shed the broker only has to do the classing and rebaling. In this way the wool is properly got up into even lines for sale, and if a grower has only a small number of sheep, consisting of mixed breeds or crosses, these fleeces are weighed out, classed into their respective bins, and then baled from those bins. Although a farmer may have, say, only half a dozen Southdown fleeces in his clip, those fleeces are classed with Southdown wool from other farmers, after which each line is grouped for the sale. It is to the small farmer's advantage to have this done, because the grouped lines of wool are even in quality and condition, and the buyer can make his valuation easily and bids with greater confidence than if all qualities were contained in the same bale.

SHEARERS' TALLY-BOARD.

A tally-board is very handy in the wool-shed at shearing-time, and can be readily made with a piece of dressed white-pine or thick card-board. The sample hereunder shows a good arrangement.

Date.	Shearers' Names.				Daily Total.	Aggregate.
	B. Butcher.	W. Burt.	R. Burt.	W. Blythe.		
Oct. 9 ..	26	24	20	19	576	576
	32	31	26	25		
	33	32	27	27		
	24	23	21	21		
	24	23	21	21		
	21	19	18	18		
	—160	—152	—133	—131		
„ 10 ..	26	24	20	20	589	1,165
	33	32	27	26		
	33	33	27	27		
	25	23	21	21		
	25	24	21	22		
	22	20	19	18		
	—164	—156	—135	—134		
„ 11 ..	28	26	21	21	616	1,781
	34	33	29	29		
	34	33	29	29		
	26	24	22	21		
	26	24	22	22		
	23	21	20	19		
	—171	—161	—143	—141		
End of shearing	495	469	411	406

By showing each shearers' daily total in this manner on the right-hand side of his column the figures stand out clear and distinct, and are quite easy to total up after shearing is finished. The board should be deep enough to complete the shearing, and wide enough to carry all the shearers' names.

POISONING OF STOCK BY SHEEP-DIP: A WARNING.

It appears to be necessary to caution the farming community regarding the use of sheep-dip—especially the poisonous kinds—for purposes other than those indicated by the makers. The Department has learnt of several cases of farm animals being poisoned by sheep-dip used in altogether wrong ways. In a recent case several horses died as a result of being washed with a solution of arsenical dip to rid them of lice; the solution seemed to have been far too strong, absorption from the skin took place, and death ensued.

—Live-stock Division.

PASTURES AT WAIMAUNGA EXPERIMENTAL FARM.

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THE cultivation, liming, and manurial treatment of the fields at Waimaunga Experimental Farm were dealt with in the *Journal* for May, 1923. The establishment and maintenance of good pastures being a matter of vital importance to Westland farmers, a brief summary of the present conditions of the pastures on this farm should prove useful to those concerned. The reader must understand that the dominant grasses on the farm when the Department took possession were brown-top and sweet vernal, with a lesser proportion of Yorkshire fog and creeping-fog. The better grasses would not hold for more than a year or two, and clovers never established themselves. All the farm pastures have been consistently stocked, and their present condition is not in any way due to light stocking with the object of preservation.

FIELD 1.

This field was sown in November, 1921, with a temporary-pasture mixture of 20 lb. Italian rye-grass, 10 lb. perennial rye-grass, 4 lb. cow-grass, and 1 lb. alsike per acre. It has given a consistent growth of good feed during the summer months, but is now becoming thin in patches, and brown-top is in evidence on the poorer parts. It must be remembered that this field received no rotation cropping to put it in good heart for grass, but was merely sown, following the ploughing and working up of the old brown-top and sweet vernal pasture. This practice is not considered the best, but is necessary at times to secure a prompt supply of palatable feed. Thus the field was sown in temporary pasture with the object of later carrying out rotation cropping and putting it into good condition for permanent pasture.

It is safe to say that the payable life of this pasture is at least four years, but with a view to maintaining the fertility of the soil to the standard of the better grasses such as perennial rye-grass—thus avoiding the expense of ploughing, cultivation, manuring, and seed—it has been top-dressed with artificial manures and carbonate of lime according to the following scheme: (Area 1) basic slag, 3 cwt. per acre, cost £1 2s. 6d. per acre; (2) control area, no manure; (3) superphosphate and Nauru phosphate, equal parts, 3 cwt., cost £1 1s. 9d.; (4) carbonate of lime, 1 ton, cost £1 2s. 6d.; (5) carbonate of lime, $\frac{1}{2}$ ton, and superphosphate, 1½ cwt. (to be applied this spring), cost £1 2s. 10d.

FIELD 2.

Field 2 was sown with a temporary-pasture mixture of 30 lb. Italian rye-grass and 3½ lb. cow-grass per acre in September, 1922. If any fault could be found with the commencement of this pasture it would be the too prolific growth of cowgrass, which retarded the Italian rye-grass. The seeding of this field was heavier than was intended; 26 lb. of Italian rye-grass and 3 lb. of cow-grass per acre was the mixture prepared, but the sowing-machine ran very freely, with the result indicated.

This field yields a plentiful supply of feed during the summer months, but little growth in the winter. There are now too many open spaces which allow room for weeds and inferior grasses to establish. The portion not sown with the temporary mixture was sown with a more permanent mixture, including perennial rye-grass and white clover; it is carrying much closer sward, and is always kept more closely grazed by stock.

FIELD 3.

Sown in the autumn of 1922 with a permanent mixture of 18 lb. perennial rye-grass, 3½ lb. Italian rye-grass, 3½ lb. timothy, 3 lb. crested dogtail, 6½ lb. cocksfoot, 2½ lb. cow-grass, and 1½ lb. white clover per acre, this field now has a most excellent and improving sole of pasture. The southern portion of this field was sown late in April (1922), continuous wet weather delaying the sowing, and the take was poor. A surface sowing of this part was made in the following spring—8 lb. perennial rye-grass, 8 lb. cocksfoot, 2 lb. crested dogtail, 2 lb. cow-grass, 1 lb. white clover per acre—and it now carries a pasture equal to the other part, if not better. The whole field carries a better winter-producing pasture than those sown in temporary mixtures.

FIELD 4.

This field was sown in February, 1921, with a temporary-pasture mixture consisting of 15 lb. perennial rye-grass, 15 lb. Italian rye-grass, 3 lb. timothy, 2 lb. alsike, and 2 lb. white clover per acre. In the autumn and winter of 1923 the field did not look very promising, the pasture deteriorating, with much sweet vernal in evidence and clovers not so good as one would expect. It was therefore top-dressed in the early spring (1923) as follows: (Area 1) superphosphate, 2½ cwt. per acre, cost 17s. 6d. per acre; (2) superphosphate and Nauru phosphate, equal parts, 2½ cwt., cost 17s. 2d.; (3) basic superphosphate, 2½ cwt., cost 18s. 9d.; (4) basic slag, 2½ cwt., cost 18s. 9d.; (5) superphosphate and blood-and-bone, equal parts, 2½ cwt., cost £1 4s. 8d.; (6) control area—the best portion of the field.

All these top-dressed areas have shown a considerable improvement, and now equal the control plot, especially in clover content. The field was not stocked as heavily as one would desire from the beginning of January to the middle of April last; consequently there was a good roughage of feed in the month of May, when seventeen head of cattle—two-year-old heifers and dry cows—were put on. The total area of the field is 13½ acres; this has wintered them well, with plenty of rough feed left, the stock freshening up and putting on condition.

GENERAL.

Judging by observations at Waimaunga and on farms throughout this coast, temporary pastures should be limited to areas for the providing of the necessary bulk of feed at the required time. Such pastures give a great supply of excellent feed for the first two years, but then far too many open spaces appear and allow moss, weeds, and inferior grasses to establish. A pasture of the permanent grasses will not yield the same bulk of feed for the first year or so, but will give a more consistent supply all the year, and a closer sward of pasture is formed; therefore moss and inferior grasses do not have the same chance to flourish.

SEASONAL NOTES.

THE FARM.

ROOT CROPS.

SOWINGS of mangolds, soft turnips, and carrots may be commenced any time after the middle of October, according to the locality or the particular field to be used, the warm situations, of course, coming first. In colder and higher localities it is better to leave sowing until the end of the month. Another factor must be borne in mind, however. The grass-grub beetle, which, it has been shown, does the damage often attributed to the "turnip-fly," is on the wing chiefly during November and early December, the date varying according to the district. If possible, therefore, sowing should be made some time before or just after the period at which the beetle is most prevalent. The period of maximum emergence is earlier in the North Island generally than in the South. The damage to the crop is greater just when the plants are in the two-leaf stage. Rape is affected by the beetle in much the same manner as turnips.

Turnips.—The white varieties take on the average about twelve weeks from date of sowing to readiness for feeding. Good varieties are Purple-top Mammoth, Red Paragon, and Hardy or Imperial Green Globe. If an area of these is sown at the same time they may be fed off in the order named. The area in Purple-top Mammoth should be small, that in Red Paragon a fair size, and the main crop Green Globe. On new land soft turnips are best sown on the flat through every second coulter of the drill, at the rate of 10 oz. per acre. If the land is dirty it is best to sow on ridges 24 in. to 26 in. apart, at 1 lb. per acre, so as to be able to give plenty of inter-cultivation. Basic super is a very suitable manure, or mixtures of half super and half Ephos, Nauru, or bonedust, at the rate of 3 cwt. per acre; proprietary turnip-manures can also be used at the same rate per acre.

Mangolds should be sown in drills 21 in. to 28 in. apart, 24 in. to 26 in. being ideal for horse-work. The Globe varieties may be sown closer in the drills than varieties like Long Red and White Sugar, which grow large tops. It is a great mistake to sow mangolds in narrow drills and have to do all the cultivation by hand, instead of sowing a little wider and doing the cultivation by means of the horse-hoe. Seeding should be at the rate of from 4 lb. to 6 lb. per acre.

It is often an advantage to soak mangold-seed in water, in order to assist germination by softening the hard capsule. The soaking should be done for about twelve to twenty-four hours immediately before sowing. Half the seed may be treated in this way and mixed with the other half before sowing. If weeds are likely to be a nuisance in a mangold crop grown on the flat, it is a good plan, in order that early intercultivation of rows may be carried out, to mix a little seed of a quick-growing plant such as mustard or oats with the mangold-seed. The growth of these plants will serve to mark out the rows and assist greatly in guiding the cultivator.

Mangolds are gross feeders, and the manuring should be generous ; not less than 3 cwt. per acre should be applied, but from 4 cwt. to 6 cwt. will be found profitable on most farms. The plant likes a complete manure, and for this reason most of the special mangold-manures on the market are giving satisfactory results. Mixtures of 3 cwt. super, 2 cwt. bonedust, Ephos, or Nauru, and $\frac{1}{2}$ cwt. sulphate of potash will give good results. Salt is also very beneficial ; this should be broadcasted at the rate of 3 cwt. per acre before the seed is sown. Spent salt from the hide-shed is very suitable and cheap for this purpose. Instead of the sulphate of potash and salt, kainit at the rate of 3 cwt. per acre may be used to advantage, as this provides both potash and salt. Kainit should also be applied ahead of the sowing.

RAPE, KALE, AND CHOU MOELLIER.

Early sowings of these crops may be made any time after the first week in October, but usually about the end of the month is early enough. Chou moellier may be sown a week or two sooner than rape or Buda kale. In clean land these crops are best sown on the flat through every second coulter of the drill. If the land is dirty they should be sown in drills 24 in. to 30 in. apart, either on the flat or on ridges, the latter for preference, so as to allow of intercultivation to control weeds. If the crop is being grown for feeding green to cows, manures containing nitrogen, such as made-up rape-manures or mixtures of half super and half blood-and-bone, 3 cwt. to 4 cwt. per acre, give the best results. For lamb-fattening pure phosphatic manures like basic super, or mixtures of half super and half either Ephos or Nauru, will be found very satisfactory. Chou moellier requires a fairly strong soil, also rather heavier manuring than either rape or Buda kale.

Feeding-tests in various districts go to show that chou moellier does not taint milk to any extent if judiciously fed. Being a vigorous grower, it is not so easily affected with club-root as rape, but in badly affected land it becomes a victim to it. It is also stronger and tougher than rape, consequently the aphis and diamond-back moth do not attack it so readily. It is useful for lamb-fattening, but the lambs do not take to it so readily or fatten so quickly as on rape, and its best purpose is for cattle-feeding. It is ready for grazing in from fourteen to sixteen weeks after sowing, and may either be grazed or cut and carted out. If not grazed too hard it will give several feedings during the season ; where not required for early autumn feeding it may be left standing right into the winter.

Rape and Buda kale should be sown at the rate of $2\frac{1}{2}$ lb. to 3 lb. of seed per acre, but from 1 lb. to $1\frac{1}{2}$ lb. is ample for chou moellier. If sown in drills the plants are best thinned out to about 20 in. in the drills. Alternatively, the plants may be grown in garden plots and then transplanted into permanent situations. This enables the land to have extra working for destroying weeds. In transplanting large areas the work may be done by opening a furrow with the plough, placing the plants in position 2 ft. apart, and covering the roots with the next furrow. The manure may either be broadcasted before the furrows are opened, or scattered along the furrow before the plants are set in position, as when planting potatoes. If the land is dry the plants are best dibbled in, similarly to cabbage-plants.

THE POTATO MAIN CROP.

The main crop of potatoes should be planted towards the end of October or at the beginning of November, choosing one or other of the standard varieties suited to the district. In view of a probable export from the commercial potato-growing districts to Australia next year, special attention should be given to the class of seed sown. Any malformed or diseased tubers should be absolutely discarded. A keen lookout should be kept for scab and eelworm. The latter disease has been noticeable this season; it has a smooth wart-like appearance on the skin of the tuber.

In planting, the better method is to set up ridges with a drill plough (or single-furrow plough with a sack tied across the breast) 28 in. to 30 in. apart, apply manure between the ridges, and plant the tubers, subsequently splitting the drills to cover. A short time after planting, or just before the shoots appear, give a stroke of the light harrows (this can be done quite well by turning the ordinary tine harrows on their backs), harrowing lengthwise of the ridges. The ridges are thus knocked down to some extent, and any weeds which may have germinated meanwhile are killed. A quick method of planting is to put in and cover the seed and manure at every third furrow of an ordinary plough. A suitable manure under average conditions is 3 cwt. super, $1\frac{1}{2}$ cwt. blood-and-bone, and $\frac{1}{2}$ cwt. to $\frac{1}{2}$ cwt. sulphate of potash per acre. The addition of stable manure, where available, is very profitable, and the artificial mixture can be cut down accordingly.

CEREALS.

The sowing of spring cereals should be completed in South Otago and Southland during October. It is inadvisable to leave this work too late in the month, but if conditions are not suitable for early sowing the quantity of manure should be increased for the later crops.

Any recently fed-off cereals should be harrowed. It is good practice to sow a few pounds of cow-grass to provide feed on the stubbles after harvest; clover assists the growth of cereals.

PASTURE-MANAGEMENT.

Care should be taken during the coming month that pastures are evenly grazed, and, if there is any indication that stock are neglecting portions of a field, every endeavour should be made to have these cleaned up by dry stock, followed by harrowing, so that the growth may be even during the summer. Watering-places should be given any necessary attention before any dry spell occurs.

SUMMER FALLOWING IN CANTERBURY.

Land badly infested with twitch that is intended for summer fallow should be ploughed in October, in order that full advantage may be taken of the drying nor'-westers which are so common in the spring and early summer. Cross-ploughing and grubbing at frequent intervals should be resorted to later. It should be borne in mind that an implement such as the disk harrow, which cuts the twitch-rhizomes into pieces, should not be used, as such pieces grow just as easily as the larger "roots." In spring working of twitch-land it should be the aim to keep the clods large, so that they may dry out on the surface of the land.

The use of cleaning or smother crops is to be recommended only when a bad twitch area has been so far controlled as to lessen the amount and vigour of that portion which seems inevitably to remain. Even then a smother-crop can be successful only on land which is normally capable of growing a fairly heavy crop. Horse-beans, among other more common farm-crops, have been found very good for cleaning purposes when sown in 18 in. to 21 in. rows and intercultivated for as long as is practicable. Seeding is at the rate of about $2\frac{1}{2}$ bushels per acre. The beans make a valuable horse-feed.

—*Fields Division.*

THE ORCHARD.

CULTIVATION.

WITH the approach of summer, which often brings hot and dry winds, every endeavour should be made to have the orchard in a good state of cultivation. Orchards left uncultivated or in a semi-neglected condition will inevitably feel the effects, and this will be reflected in the yield later in the season. There are many instances in which quite satisfactory results have been obtained where orchards have been sown in clovers. However, this is a practice which needs careful thought and handling, otherwise disastrous results will follow. The soil must be rich and the rainfall well up to the average, and in practice several things are necessary in order that the trees and fruit may not suffer. In the first place, a considerable strip around the trees should be kept cultivated, this work being usually done by hand. The clovers should be cut several times during the year, and the cuttings placed on the cultivated portion. This material will serve as a mulch, and will very soon decay and add much organic matter to the soil. Where this is carried out a liberal dressing of lime will be necessary, otherwise the land may become unduly sour. If the growth is cut and taken away to serve as feed for stock, trouble will be sure to follow.

Where cultivation is carried out it should be done in a fairly systematic manner. It is impossible to eliminate all hand-work, but it can, however, be reduced to a minimum with the implements now in general use. The neglected strips sometimes seen round trees are not conducive to the best results, and would not be permitted in any well-managed orchard. The chief reason for cultivation during the spring and summer is to conserve the moisture in the soil, which in turn will stimulate wood-growth. This is quite a necessary function which every tree should perform at that period, otherwise it is not possible for the tree to thrive in the manner desired. Moreover, trees that fail to make any wood-growth seldom return consistently payable crops. Methods of cultivation vary with different classes of soil. Where soils are light and friable after the ploughing has been completed, a spring-tooth cultivator does excellent work. If the soil is heavy, a disk may be found more suitable during the spring. Almost all later cultivation can be done with tine harrows.

SPRAYING.

This work must not be neglected, and readers are referred to the directions given in the *July Journal*. A careful watch must be kept for green and black aphid, which is often troublesome on stone-fruit during the spring. As soon as the leaves commence to unfold, the insect begins to work, and no time should be lost in combating it. The most effectual spray to use is Black Leaf 40—1 in 800. The spray is much more effectual when about 3 lb. of soap is used with each 100 gallons of water. A cloudy day or towards evening is the best time to make the application. A second spraying about two weeks later will be found of great value.

A word with reference to the working of spray-pumps. Almost all pumps of any size have an air-chamber which may be used to greater advantage than is often the case. Whether this chamber is on a large hand-pump or a power pump it should be used as an aid to the easier maintenance of pressure. When ready to commence spraying, place the suction-hose into the liquid and give several strokes with the pumping-handle, then throw out the suction-hose and continue pumping until the pressure-gauge shows between 40 lb. to 60 lb. pressure. Return the suction-hose into the liquid and continue pumping. If the pump is worked in this manner it is very much easier to maintain an even pressure, and, moreover, there is less strain on the pumping outfit; the method is in every way more satisfactory.

—L. Paynter, Orchard Instructor, Christchurch.

CITRUS-CULTURE.

Fortunately for the growers of citrus-fruit in the Auckland District, very little frosty weather was experienced during the winter now concluded, and therefore very little damage has been caused to citrus-trees generally. However, in cases where laterals or the heads of leaders have been cut back by frost, the affected areas should be immediately removed—cutting back well below any damaged portion into live tissue and to a prominent bud or lateral. As mentioned in previous notes, brown-rot has been very bad in several localities, so bad, indeed, in one or two groves that the wood of the trees has been killed outright on such portions as were supporting fruit at the time that the fruit and foliage became infected. Such wood should receive the same treatment as that which has become frosted, and be destroyed by burning. All diseased fruit and leaves should also be removed, where at all practicable—either buried to a sufficient depth to preclude the possibility of further distribution of spores, or removed to some safe distance from the grove.

Spraying: The spraying programme to be carried out in October includes (1) the application of red-oil emulsion, 1-40, to both lemon and orange trees, during the earlier part of the month, for the control of sucking-insects generally; (2) the application of bordeaux, 4-4-40, as soon as the blossom-petals have dropped from the main spring flowering, to be followed, of course, by later applications should conditions demand.

Manuring: The manuring of citrus-trees should be undertaken immediately, and the following applications are recommended: For bearing trees, 6 lb. to 8 lb. of artificial fertilizers composed of two

parts of blood-and-bone, one-quarter part of sulphate of potash, and three-quarter part of high-grade superphosphate; for young trees, two to five years old, 2 lb. of blood-and-bone at the present time, with a small dressing of nitrate of soda or sulphate of ammonia during the growing season, the latter to be applied as a top-dressing and hoed lightly in round the feeding-roots.

Cultivation: The spring cultivation may now be put in hand. Where lupins have been grown between the trees for the purpose of adding nitrogenous matter and humus to the soil they should be ploughed in as soon as circumstances permit.

Picking: The final picking of Poorman oranges should be made immediately, and put on the market.

FIREBLIGHT.

Persons occupying land upon which hawthorn has recently been growing, in areas situated within the boundaries of the Third Schedule of the Fireblight Act, are reminded that their obligations do not cease with the destruction of all hawthorn growing on the land before 30th June, 1923, but that any plants which may appear subsequently must forthwith be completely destroyed.

—J. W. Collard, Orchard Instructor, Auckland.

POULTRY-KEEPING.

LATE HATCHING.

It may be well to reiterate that if only profitable stock are to be reared, the last of the eggs for the season should now be in the incubators or under broody hens. Chicks brought out, say, in the middle of October are rather on the late side, and are starting their lives under a big handicap as compared with those hatched earlier in the season. The production of late-hatched stock is the weak link on many unsuccessful plants. Some amends, however, may be made with such birds if they are placed under ideal conditions. Not only should they be provided with an absolutely clean piece of ground to run on, but good shade and shelter must not be overlooked. In addition, the food supplied should be of sound quality, and, above all, an abundant supply of succulent green material—that great essential for their welfare—provided for the young birds.

BROODER TROUBLES.

Leg-weakness: If the chickens are going weak in the legs and showing signs of a wobbling walk, it indicates that they are huddling at night and require more warmth. The trouble is often intensified by the lack of sufficient bedding on the brooder-floor, especially when the floor is very smooth. The constant slipping of the chickens on

the smooth surface during the huddling effort brings on a spreading and weakening of their delicate legs. On the first sign of this condition, additional warmth should be applied, and everything done to make the chickens spread out, indicating that they are comfortable. Once chickens have acquired the habit of crowding in corners as a result of being chilled, it is often difficult to break them from it, quite irrespective of any additional heat that may be applied. In such cases, and in order to prevent leg-weakness and other troubles, it is a good plan to first cover the floor of the brooder with a thin layer of chaff, say, $\frac{1}{2}$ in. deep. On this, place a single piece of sacking the full size of the brooder-box, and cover it with chaff to a depth of about 1 in. This will not only provide a comfortable bed for the chicks, but, in addition, will induce them to spread out. It will also prevent them from slipping, with its consequent bad effect on their legs.

Unabsorbed yolk: Much of the mortality which takes place during the early brooder stages is due to the yolk (which is drawn into the chicken's body just before it leaves the shell) failing to digest. In such cases the yolk, instead of being gradually absorbed to provide nourishment for the chick during the first few days, as nature intended, gets into a more or less hardened state, which prevents it from being digested. A chicken thus affected will sometimes live for weeks, but as a general rule it will die even when receiving the best of care and attention. Thus when this condition is disclosed in a *post-mortem* examination the cause of death will be made apparent. It is generally believed that failure of the yolk to digest is due to feeding the chicks too soon after hatching, or to overfeeding during the early brooder stage. It is also often considered that breeding from overfat hens is responsible. While all these factors may have some influence in regard to this undesirable condition, experience goes to show that it is due more to improper incubation than to any other cause. This is confirmed to a great extent by the fact that the trouble is seldom present in chickens that have been hatched by the natural mother. There it will be found that the yolk in its sack is in a more or less liquid state, which enables it to run freely and finally become absorbed. With incubator-hatched chicks the chief cause of the trouble is due to having the temperature too high during the whole or a part of the incubating-period, thus causing half-baking of the yolk and rendering it incapable of absorption. If this trouble is to be prevented the yolk must remain in liquid form and be used up as food for the growing bird. It is always advisable to open up any chicken that dies, in order to discover, if possible, the cause of death. Chickens often die from eating the joint of the grain, stalk in the chaff, and other fibrous material. If a supply of fine sharp gravel grit is always available to the young birds right from the start, it will go a long way towards preventing trouble in this respect.

Sundry: The common mistake should not be made of putting more chicks in the brooder than it is capable of brooding to the best advantage. Overcrowding is simply courting disaster. This practice is bad enough in any branch of the plant, but it is especially disastrous with the young tender stock. Strict attention to cleanliness is another

important matter which must not be overlooked. If the quarters are allowed to become foul, the presence of parasites, lice, mites, &c., is encouraged. Before a new batch of chicks is placed in the brooder, the latter should be well cleaned and disinfected.

FIGHTING VERMIN.

With the approach of hot weather constant warfare should be made against vermin. I cannot advise too strongly the use of tar to cover up crevices and joints, the common harbouring-place of insect pests, especially of that vicious little night marauder, the red mite. Tar thoroughly applied means that every crevice and crack is covered up. Vermin are most active in hot weather, and at such a time the tar is soft and is then most objectionable to insect-life. A good feature of tar is that it is a timber-preservative. An advantage tar presents over whitewash is that, while it is not so attractive a covering for timber, it can be thoroughly effective, whereas whitewash is too often ineffective and a deceptive covering. I have seen fowlhouse interiors which looked beautifully clean to the eye, but with swarms of insects breeding behind the caked whitewash, while the red mites were thick in out-of-way corners which the whitewash-brush could not reach. The red mite usually makes its first appearance under the perches, and to prevent this I would advise giving the latter frequent applications of kerosene or strong disinfectant.

Nests are another source of contamination—in fact, the principal harbour for fleas. These pests mostly hide under the nesting-material, and cause no end of annoyance to the birds when they visit the nests to lay—a common cause of their laying in odd corners of the house. Nests should be constructed in such a way as to be easily removed and effectively cleaned.

The value of a dust bath in assisting poultry to free themselves from vermin is not generally appreciated as it should be. It is common to see fowls badly infected with vermin without an inch of soft ground for them to make a dust bath in. Where fowls are provided with an outside run, the best place for a dust bath is on the sunny side of a shrub. Any dusting-place should be frequently spaded up. Where it is provided in the house it will not always be appreciated by the fowls unless it is frequently freshened up by the addition of new material. It should not be forgotten that feather-pulling is frequently caused by birds being badly infested with vermin—a minute mite which causes severe irritation at the roots of the feathers. A bird affected in this way will invite her mates to pluck out her feathers as a means of freeing herself from the irritation. Cases have certainly occurred where feather-pulling has taken place in flocks practically free from vermin, but in such instances the birds have been very closely confined, and have not been provided with plenty of scratching-material to keep them occupied and in a healthy condition. Once fowls acquire the bad habit of feather-pulling there is no effective cure; prevention is the only safe course, the great essentials being a good outside range under the most natural conditions possible, combined with clean quarters and constant warfare against vermin.

—F. C. Brown, *Chief Poultry Instructor.*

THE APIARY.

FEEDING AND WATER.

A CONSTANT watch should be kept on the stores in the hives. Usually at this period there is a steady drain on the food-supply to meet the incessant demand for brood-rearing. If an examination of the hives was carried out, as advised in my July and August notes, then the losses attendant upon spring starvation will have been avoided; but it is not wise to neglect to feed where stores are short, as the spring is the most critical period for the beekeeper. The weather conditions are not always favourable for the bees to work the early spring blossoms, and in populous colonies the food-supply should be augmented—but only where there is a noticeable shortage. If there is a good queen in the hive she will usually begin laying as fast as weather conditions will permit, and it is a mistake to start feeding unless stores are very short, as it stimulates brood-rearing, and, when commenced, must be carried on until a natural flow sets in from the fields.

Abundance of stores is certainly required at this season, and if the beekeeper finds that additional food is required it can be supplied in the form of combs of honey or as a syrup. The feeding of combs of honey should not be practised unless the beekeeper is sure that his apiary is free from disease, as there is always danger of spreading disease by this method. No better substitute for honey has been found than cane-sugar, and it is far safer to use it at all times if the beekeeper is not satisfied as to the health condition of his apiary. Honey from an unknown source should never be fed. There are many feeders on the market. The division-board feeder is the best to use at this season, as it will serve the double purpose of feeder and division-board in cases where the colony is not strong enough to occupy all the frames in the hive.

In the spring months, when brood-rearing is at its height, bees require a good supply of clean water in the apiary. If this is not provided they are apt to become a source of annoyance at drinking-troughs and by congregating round domestic supplies. Brood requires a great deal of water in addition to pollen and honey. The amount depends largely on how much brood-rearing is going on, and to what extent nectar is coming in from the fields. If water is not close at hand many bees are lost in trying to obtain it, more especially as the weather is often changeable and boisterous in the spring.

Many simple contrivances can be made to supply water. "Simplicity" feeders make excellent vessels for the purpose, but they require to be filled frequently. To start the bees taking water from any particular place it is a good plan to slightly sweeten the first water given.

DISEASE.

At all times when examining the combs keep a strict watch for symptoms of disease. Beekeepers should never lose an opportunity of acquainting themselves with foul-brood in all its stages. At this season, if isolated capped cells are discovered in frames which contain no other brood, these should be treated as suspect and subjected to the test for foul-brood. If on opening a cell, when a sharp-pointed piece of stick

is inserted, the dead imago can be lifted out complete in form, the beekeeper may conclude that if dry it is a case of starvation, and if moist a case of chilled brood. If, however, the contents of the cell adhere to the point of the stick in a ropy ill-smelling mass it may be concluded that the hive is diseased. There is perhaps no surer indication of the presence of foul-brood in the hive than the objectionable smell of the decayed larvæ. Beekeepers who once recognize this odour will have no difficulty in detecting the disease in that stage. The last and most difficult form of foul-brood is the dry stage, and in this form it has baffled beekeepers of long standing. Only a careful examination can reveal its presence. The diseased larva, having dried to a scale, adheres to the lower side of the cell, and can be removed by scraping with a sharp-pointed instrument. If the aforesaid isolated capped cells on being opened appear at the first glance to be empty, they will almost invariably yield a scale if examined, and the hive should be marked for treatment.

Wherever there is a fair yield of nectar from spring flowers the beekeeper would do well to take advantage of the warm days of the month to treat any cases of disease which he may have noted earlier in the spring. However, no hard-and-fast rule can be laid down in this matter, everything depending on locality and weather conditions. In some districts it would be almost fatal to treat the bees in October; in others where right conditions prevail it may be carried out with ease and safety, and the bees brought into good condition by the time a surplus may be expected. Wherever treatment has been undertaken the colonies should be watched in order to see that there is no danger of starvation, and where the spring flow is not considered heavy enough it should be supplemented by liberal feeding.

WHEN TO START AN APIARY.

One of the questions most frequently asked by the would-be beekeeper is, "When should I start beekeeping?" Probably no time is better than when the bees are swarming. If the beginner procures a good prime swarm, leaves it in a clean box for three days, and then hives it in a new hive, on new frames, with full sheets of foundation, he has made the best start it is possible to make in beekeeping. The leaving of the swarm in a box for three days is purely a preliminary measure in case there is any disease in the apiary from which the swarm is procured. By the end of three days the bees will have consumed the honey they brought from their old home, and at the same time have disposed of the foul-brood germs (which are innocuous to the adult bee), and be ready and willing to be transferred to their permanent home to start brood-rearing in earnest.

As the bees will have become used to their box by the end of three days, it is as well to carry out the transfer with care. It should be done at sundown on the third day. The hive should be placed in position, a clean sack spread over the alighting-board and surrounding ground, and the hive-body raised from the bottom-board about an inch or so by means of a stone or piece of wood. The box should be firmly grasped with both hands, inverted over the sack as near the hive as possible, and the bees dumped with a brisk movement on to the alighting-board. One shake will dislodge the greater part of the cluster, and the few remaining bees can easily be shaken out

and the box taken away. Be sure the queen is out of the swarm-box, and the bees will crawl in a steady stream into the entrance, their progress becoming more rapid as soon as the queen has entered the hive. When the queen is safely inside, the hive body should be lowered and the entrance slightly contracted.

It is advisable to place a feeder inside the hive. Even if the weather is good and a fair supply of nectar available, a few pints of good warm syrup fed a day or two after hiving will work magic with the new colony, and enable it to build up in time to yield a surplus when the main flow sets in.

The beginner should always start in the spring, and on no account should he attempt to commence with established colonies unless they are purchased from a breeder who guarantees his bees to be clean. Old hives are too apt to be homes of disease, and are only fit to be handled by the experienced apiarist.

—*E. A. Earp, Senior Apiarist.*

THE GARDEN.

VEGETABLE-CULTURE.

IN October crops of asparagus, rhubarb, and salads should be fed with fertilizers as required to induce strong growth. Beds of rhubarb that have been down for four or five years and have had the early crops pulled from them may be lifted, cut up, and replanted on well-prepared new ground. Thin seedling crops as soon as they are ready. Plant the balance of the potato crop, and sow the main crop of carrots and red beet, also peas, leeks, celery, silver-beet, and dwarf and runner beans. These beans deserve more attention from the gardener; they are easily grown. Whether the season is wet or dry makes little difference to them, while they provide excellent dishes of green beans in summer and dry ones in winter. Sow down a bed of lettuce thinly, with the view of thinning them out and growing the crop in the seed rows. Towards the end of the month sow broccoli and brussels sprouts for planting out towards the end of the year. It is a common mistake to sow these beds too thickly; this should be avoided. Those intending to grow kumaras (sweet potatoes) should select a piece of moist, warm, friable soil, and give it thorough preparation ready for planting out in November.

TOMATOES.

While it is unwise to put out tomato-plants too early, each grower must solve for himself the problem of when to plant out. In some areas of the Dominion that time will arrive during the month of October, and for others rather later. In windless, sheltered districts sticks are used to train the plants on, and are perhaps best, but in more exposed localities a wire trellis is preferred, and in the drier sections plants are sometimes trained to four stems and are allowed to grow without support. Harrow in a dressing of manure before planting, and endeavour to have the plants firm, well rooted, and sturdy. To obtain this, keep them rather on the dry side while hardening them off, and plant them out before they become crowded. Plant firmly in a firm bed.

Under glass, the first and second flower-cluster will be setting, and as these are of the greatest value every attention should be given them. It is usual to keep the house warm now, and with rather a dry atmosphere; specially avoid extremes and sudden fluctuations. During the middle of the day, especially in fine weather, it is worth while going through the house about noon and shaking or tapping the vines with a view to scattering the pollen. Study the plants, note the colour, the set of the leaves, and whether growth be slow or over-luxuriant; learn to understand their wants and give them what is necessary. Be specially quick to note the first sign of trouble, to know if it be serious, and immediately apply a suitable remedy. During the busy spring season the necessary time for this is hard to find, and too often a portion of a crop develops extensive trouble before it is detected.

SMALL-FRUITS.

Cape-gooseberry plants will also soon be ready for putting out; 3 ft. apart and 6 ft. between the rows is good spacing. Egg-plants and capsicums are best set out later.

Take advantage of bright, dry weather to hoe and clean up strawberry-beds, stopping all runners on fruiting plants. Backward plants should be coaxed with a light dressing of nitrate of soda, and plantations affected with leaf-spot should be sprayed with bordeaux, 4-4-40. As soon as the plants commence to blossom give them a good dressing of nitrate of soda and lay a mulch between the rows. This is a big task, but it is very rare that it can be dispensed with satisfactorily.

Small-fruits have suffered seriously in the past from the lack of manuring and spraying. Spray raspberries before flowering, and gooseberries and currants after flowering, with bordeaux, using the above-mentioned formula. It is rare to see a break of these plants that is not in serious need of this attention.

TOBACCO-GROWING.

The seed-beds should now be well forward. Thin the plants out where they appear to be crowded. Success depends on an even lot of sturdy plants being available for setting out. A week or so before setting the plants out remove the hessian cover; commence on a dull day so as not to scald the seedlings. The evening before pulling the plants give them a good watering. Pull the plants carefully, and put them, roots down, in a wooden tray or basket, and stand them in a shady place until required for planting. Needless to say, the land to be planted should be in a clean friable condition, with the manures well harrowed in. The usual custom here is to plant about 3 ft. apart, and the land should be marked out at that distance both ways, and the plants put in on the intersections. A convenient arrangement is for a boy to carry the plants and place them in position, and for a planter to follow and dibble them in. The work is best done on a dull day, or, if that is not convenient, during the afternoon. The plants are best watered in. In districts not subject to hard late frosts the plants may be put out in October with advantage.

—W. C. Hyde. *Horticulturist*.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

TREATING SHEEP FOR PARASITIC GASTRITIS.

"CAMPUS," Otaki Railway :—

Would you please let me know the usual quantities to use when dosing lambs with turpentine and milk?

The Live-stock Division :—

The use of turpentine in the treatment of parasitic gastritis has not been satisfactory, but if you are determined to use it the dose, a teaspoonful, should be given in a tablespoonful of sweet oil or half a cupful of warm milk. The animals to be dosed should be fasted for at least twelve hours. The dose should not be repeated for at least three days, as turpentine has a marked effect upon the kidneys, and too frequent or too large dosing might cause permanent injury to the kidney substance. A more satisfactory treatment is the use of a 1-per-cent. copper-sulphate solution in water—about 3 oz. of the solution for yearlings and older sheep, and half as much for lambs three months and over. Porcelain or enamel ware should be used in making the solution; the copper sulphate will corrode metal. Prevention plays a very important part in the treatment of this disease, which is spread by the eggs of the parasite on the pastures. Lambs and uninfected sheep should be kept away from the infected ones; the lambs, which are more prone to infection than older animals, should be given the cleanest and driest paddocks. Infected pastures can be rendered practically safe by ploughing, the eggs and young worms being turned in and buried. If sown in forage crops, sheep might be put on them later with comparative safety. Draining should prove of benefit, as lack of moisture is unfavourable to the parasite. During treatment the sheep should get an ample supply of good sustaining food.

LOTUS MAJOR.

"LOTUS MAJOR," Limehills :—

I would be glad to know (1) if *Lotus major* will grow and thrive on peaty land that has not been limed; (2) which ground is most suitable for it—peaty, or good heavy land that has been cultivated for, say, fifteen years; (3) whether for seed, is it advisable to sow pure or with some other grass; (4) how soon after sowing it would be ready to cut for seed; (5) if sown in a grass mixture with turnips, would it survive under ordinary conditions; (6) does it respond to lime like other clovers?

The Fields Division :—

Presuming that drainage has been carried out, *Lotus major* will grow and thrive on peaty land which has not been limed. Good heavy damp ground that has been cultivated for fifteen years should grow *Lotus major* well, provided the fertility of the soil has not been too exhausted. For seed purposes *Lotus major* can be sown with oats at the rate of 4 lb. per acre, or in a permanent grass mixture at the rate of 2 lb. per acre. Whatever method is adopted for the establishment of the plant, a seed crop will not be obtained the first season. With good growth a crop sufficient to warrant harvesting will be secured in the second season. If sown in a grass mixture with turnips, as you suggest, the *Lotus major* would survive under ordinary conditions. The plant responds by increased growth to applications of lime. A most important point is to be certain that the seed sown is pure *Lotus major* and not mixed with *Lotus hispidus*. Parts of Southland appear to be excellently suited for *Lotus major* seed-production, some of the yields secured having been higher than those in any other part of New Zealand.

RIDDING LAWN OF MOSS.

G. H. LONEY, Wellington :—

Will you kindly let me know the best way of eradicating moss in lawns? My lawn is very badly infested. I have raked it over and sown brown-top seed, but the moss has appeared again as badly as ever.

The Horticulture Division :—

Grassland growing much moss is usually poor and sour. To counteract such a condition it is advisable to apply a top-dressing in spring or autumn—during the growing season—after first raking off most of the moss. Take one part of powdered lime and two of a good clean loam; mix them and apply a dressing of about a $\frac{1}{4}$ in. in-depth. In most localities this could be done any time after the middle of July.

CLEANING OUT A SKIM-MILK PIPE-LINE.

E. A. CLAYTON, Whangarata :—

Will you please let me know the best means of cleaning out a skim-milk pipe-line? The milk is pumped along this line ($\frac{3}{4}$ in. galvanized piping) direct from the separator, and the pipe tends to become blocked. Water is regularly pumped through after each milking, but the deposit seems to form in spite of this. Would washing-soda affect the galvanizing, and so poison the pigs?

The Dairy Division :—

The best way to keep the pipe clean would be to make it detachable from the pump with a union joint, and, if a long length, to divide it up into short lengths so that each can be easily taken down. In cleaning, first run through cold water, next use hot water in which a little washing-soda has been dissolved, and brush out with a spiral brush, then rinse with boiling water. Washing-soda used in this way will not harm the pipe. The soda solution should, of course, not be fed to pigs.

SAVING WHITE-CLOVER SEED.

“WHITE CLOVER,” Masterton :—

Will you kindly inform me regarding the saving of white-clover seed? The paddock I contemplate saving is land of a light nature, and the pasture consists mainly of white clover with a fair sprinkling of brown-top, cocksfoot, rye-grass, and trefoil. Can the trefoil-seed be separated from that of the clover, and, if not, does it decrease the value of the clover-seed? When would it be advisable to shut up the paddock, and does it require closely grazing beforehand? What is the ordinary method of harvesting?

The Fields Division :—

You would require to graze your paddock carefully from time to time during the early part of the season up to about December, when the flush of grass is about over, and then shut up for seeding the white clover. The better method is to heavily stock the paddock at short intervals, rather than to continue to graze steadily up to time of closing. The object should be to cope with grass-growth, while at the same time allowing the clover to become invigorated. White clover is sometimes difficult to harvest, as, being at best short and dense in growth, it hangs on the cutter-bar of the mower, so that a sprinkling of grass-heads throughout the crop is really necessary to facilitate mowing, and again in raking. Endeavour to catch the crop when the majority of the seeds are ripe and bright in colour. Avoid leaving it too late, otherwise many of the seeds become dark in colour, which greatly affects the value of the sample. Suckling clover cannot be separated from white clover, hence it is recognized as an impurity in the latter, and the price varies accordingly. After cutting and raking, the crop should be cocked and stacked like hay. If a clover-huller is not available, the material would require to be put through an ordinary threshing-mill and afterwards cleaned by one of the seed firms. Much suckling-clover seed can be avoided by arranging to have the white clover come in rather late, as suckling will then ripen first and drop the majority of its seed before cutting commences.

WEATHER RECORDS: AUGUST, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

AUGUST is regarded as the last month of winter in New Zealand, but this year it exhibited more of the character of spring. As in July, however, the rainfall was below the mean for the same month in previous years, and especially so in Canterbury and Otago.

The first seven days were very unsettled, and ended with a cold snap, on account of a disturbance which developed off the east coast. High barometric pressure followed until about the 12th. From then until about the 18th disturbances both from the west and north accounted for changeable and very showery conditions. The barometer then went as high as 30.70 in. in the North, and remained high until nearly the end of the month, with fine sunny days and frosty nights, although during the last week there were evidences of low-pressure systems both north and south of the Dominion. The winter has been an open one in the South, and it is reported that very little snow lies on the hills.

The records of bright sunshine to hand are interesting: Auckland reports 188 hours 30 minutes; Rotorua, 160 hours 45 minutes; Napier, 159 hours 15 minutes; New Plymouth, 170 hours 10 minutes; Wellington, 123 hours 21 minutes; Nelson, 193 hours 35 minutes; Hanmer, 133 hours; Waimate, 171 hours 35 minutes; and Hokitika, 175 hours 52 minutes.

Growth was fair in the North, but backward in the South on account of the dryness and frosty nights.

—D. C. Bales, Director.

RAINFALL FOR AUGUST, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitaia	4.44	15	1.14	5.10
Russell	3.06	14	0.64	6.99
Whangarei	3.40	16	0.95	6.93
Auckland	3.72	14	0.78	4.21
Hamilton	3.20	19	0.72	4.15
Kawhia	2.92	10	0.54	4.60
New Plymouth	2.85	15	0.84	5.38
Inglewood	5.84	16	1.72	8.65
Whangamomona	5.33	21	1.40	5.80
Tairua, Thames	3.42	8	1.70	6.98
Tauranga	3.79	13	1.12	4.17
Maraekaho Station, Opotiki	7.40	10	2.30	4.75
Gisborne	3.85	18	1.06	4.50
Taupo	4.16	10	1.12	4.23
Napier	4.32	10	1.04	2.96
Maraekakaho Station, Hastings	3.25	13	0.93	3.31
Taihape	2.96	15	0.70	2.67
Masterton	4.35	18	1.09	3.26
Patea	3.26	13	0.61	3.57
Wanganui	1.97	7	0.67	2.78
Foxton	2.54	8	0.80	3.04
Wellington	4.34	17	1.20	4.40
<i>South Island.</i>				
Westport	3.91	15	0.92	6.27
Greymouth	5.60	14	0.95	7.87
Hokitika	6.64	15	1.44	9.45

RAINFALL FOR AUGUST, 1924—continued.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average August Rainfall.
<i>South Island—continued.</i>				
	Inches.		Inches.	Inches.
Arthur's Pass	5.93	7	1.85	13.13
Okuru, Westland	11.48	8	2.38	11.46
Collingwood	5.94	11	2.09	6.96
Nelson	2.62	8	1.03	3.05
Spring Creek, Blenheim ..	1.99	7	0.85	2.86
Tophouse	2.86	8	1.02	4.87
Hanmer Springs	2.13	12	0.42	2.23
Highfield, Waiau	0.97	10	0.37	2.28
Gore Bay	0.46	4	0.25	2.28
Christchurch	1.21	10	0.76	1.75
Timaru	0.74	4	0.68	1.48
Lambrook Station, Fairlie ..	1.14	3	0.88	1.53
Benmore Station, Omarama ..	0.92	6	0.41	1.50
Oamaru	0.76	5	0.56	1.76
Queenstown	0.93	4	0.45	1.80
Clyde	0.21	1	0.21	0.80
Dunedin	0.49	6	0.15	3.15
Gore	0.60	7	0.30	2.26
Invercargill	1.06	14	0.22	3.36

EGGS AND EGG-PULP IN COLD STORAGE.

A RETURN issued by the Government Statistician shows the following stocks of eggs and egg-material in cold storage in the Dominion as at 31st July last—corresponding figures for 31st March being added in parentheses: Eggs in shell, 956 dozen (44,942 dozen); egg-pulp, 325,706 lb. (840,889 lb.); frozen whites, 2,836 lb. (2,618 lb.); frozen yolks, nil (nil).

Blackleg-control — Inoculation of calves for the prevention of blackleg in the districts affected and defined in the regulations was carried out as usual during the past official year, and 45,440 head were vaccinated in the Taranaki District area. This is a slight decrease on the figures for the previous year. The need for the vaccination of calves is still apparent (states the Director of the Live-stock Division), but it is satisfactory to report that the disease does not show any increase, nor has it extended to other districts. A continuance of the restrictions on the movement of calves out of the quarantine area is necessary in order to safeguard clean districts.

British Market for Peas and Beans.—The following advice was cabled by the High Commissioner, London, on 9th September: *Peas*—Blue: Large arrival of Japanese now obtainable at £19 10s. per ton ex store; Tasmanian spot slow, sales at £19 10s. to £20; "A" grade for shipment quoted about £18 to £18 10s., c.i.f.; no inquiry for New Zealand; Dutch small hand-picked sold up to £22 ex store. Maple new crops: New Zealand spot, 72s. 6d. to 75s. per quarter; only little trade passing; September–October shipment sold at 71s. 6d. to 72s. 6d.; Tasmanian spot offered 80s. to 82s. 6d., and to arrive 77s. 6d., but price too high for buyers' ideas, and business has been done at 72s. 6d., c.i.f. London. *Beans*—English winter making up to 52s., and choice old spring up to 70s. per quarter. Chinese horse, September–October shipments Europe sold £10 10s., and October–November shipments Glasgow £10 15s. per ton.

FORTHCOMING AGRICULTURAL SHOWS.

Marlborough A. and P. Association : Blenheim, 22nd and 23rd October.
 Hawke's Bay A. and P. Society : Hastings, 22nd and 23rd October.
 Auckland A. and P. Society : Auckland, 24th and 25th October.
 Poverty Bay A. and P. Association : Gisborne, 28th and 29th October.
 Wairarapa A. and P. Society : Carterton, 29th and 30th October.
 Whangarei A. and P. Association : Whangarei, 29th and 30th October.
 Manawatu A. and P. Association : Royal Show, Palmerston North, 4th, 5th, and 6th November.
 Ashburton A. and P. Association : Ashburton, 6th November.
 Canterbury A. and P. Association : Christchurch, 13th and 14th November.
 Egmont A. and P. Association : Hawera, 19th and 20th November.
 Wallace A. and P. Association : Otautau, 19th November.
 Waikato A. and P. Association : Hamilton, 19th and 20th November.
 Stratford A. and P. Association : Stratford, 26th and 27th November.
 Hauraki A. and P. Association : Paeroa, 26th and 27th November.
 Southland A. and P. Association : Invercargill, 9th and 10th December
 Woodville A. and P. Association : Woodville, 20th and 21st January.
 Waimarino A., P., H., and I. Association : Raetihi, 22nd January.
 Pahiatua A. and P. Association : Pahiatua, 30th January.
 Clevedon A. and P. Association : Clevedon, 7th February.
 Te Puke A. and P. Association : Te Puke, 12th February.
 Dannevirke A. and P. Association : Dannevirke, 11th and 12th February
 Northern Wairoa A. and P. Association : Mititai, 17th and 18th February.
 Masterton A. and P. Association : Solway, 17th and 18th February.
 West Coast A. and P. Association : Greymouth, 18th and 19th February.
 Waiapu P. and I. Association : Ruatorea, 25th and 26th February.
 Tauranga A. and P. Association : Tauranga, 26th February.
 Franklin A. and P. Association : Pukekohe, 27th and 28th February
 Mangonui A. and P. Association : Mangonui, 6th and 7th March.
 Mayfield A. and P. Association : Mayfield, 21st March.
 Temuka and Geraldine A. and P. Association : Winchester, 2nd April.

Agricultural and Pastoral Association Secretaries are invited to supply dates and location of their shows for publication in the Journal.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 24th July to 4th September, 1924, include the following of agricultural interest :—

No. 50590: Cheese-press; J. B. MacEwan and Co. (Limited), Wellington.
 No. 51625: Fruit-sizing machine; J. H. Barr, Blenheim. No. 51906: Fertilizer; A. H. Renard, Melbourne. No. 52035: Milk-sterilizing apparatus; J. Neilsen, Denmark. No. 52136: Milk-weighing machine; C. M. Stanley and J. H. Stewart, Apiti. No. 50506: Milking-machine releaser; D. McL. Wallace (Limited), Te Aroha.
 No. 50613: Milk-cooler distributor; W. Harvey, Auckland. No. 50634: Milking-machine teat-cup holder; W. M. Moore, Palmerston North. No. 50664: Egg-preserving process; G. P. Lewis, London, and Guaranzier Limited, London.
 No. 51752: Wool-crimp; J. Main, Timaru. No. 50107: Cheese-press; S. H. Jones, Kaupokonui. No. 50751: Protective veil (beekeeper's); S. E. Gardner, East Oxford. No. 50788: Egg-crate; A. Turner, Auckland. No. 52318: Concrete fencing-post; E. Anderson, Midhurst. No. 52322: Fencing-tool; A. F. Johns, Rangiora. No. 50761: Fruit-grading machine; G. R. Dixon and F. Offen, Hastings. No. 51966: Butterfat-extracting from buttermilk; Milk Industries (Limited), Lismore, N.S.W. No. 52222: Animal-trap; H. C. Lane, Wednesfield, England. No. 52435: Pig-feeding apparatus; H. Morris, Nutley, England.

Copy of full specifications and drawings in respect of any of the above may be obtained from the Registrar of Patents, Wellington; price 1s.



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DAIRY-HERD TESTING IN NEW ZEALAND.

REVIEW OF THE 1923-24 SEASON.

W. M. SINGLETON, Director of the Dairy Division.

FINAL figures in connection with dairy-herd testing during the season of 1923-24 show that 151,214 cows were systematically tested, these falling into 188 groups or associations. This represents an increase over the previous season of fifty-one associations and 66,389 cows, or 37·2 per cent. and 78·2 per cent. respectively.

Officers of the Dairy Division controlled the testing of 37,378 cows, which were included in sixty-one associations. Several changes in administration took place: that is to say, certain associations which in the previous year were under private auspices were last season conducted by the Division, while we were relieved of certain others. Of the 137 associations in existence in 1922-23 twenty-six did not continue last season. These, however, were small organizations, the total number of cows being only 12,090.

It will be obvious that the system is working its way from district to district, so that there are now very few parts of the country which have not had experience with this work. An analysis of the situation for several years shows that some associations continue for two or three seasons and then drop out, but to revive when the original herds have been replaced by the younger stock coming on. This discounts any idea that quite a number of associations operate

for a short period and then permanently discontinue. This phase of the question, however, cannot be handled in detail in the present review.

A special endeavour has been made to obtain yield returns from as many associations as possible, and we have been successful in procuring figures for 107,201 cows. Owing to the large number of associations now represented in the summaries—namely, 138—it has been found necessary to abandon the publication of individual association averages, and to confine our tables and comments to the main groups into which the subject falls.

The following table gives the position so far as available returns are concerned, associations controlled by Dairy Division officers and those under private control having been combined. Figures for any cow which milked less than 100 days have been excluded:—

Table 1.

	1923-24.	1922-23.
Number of associations	138	81
Number of herds	3,820	2,085
Number of cows	107,201	50,683
Average number of herds per association	28	26
Average number of cows per herd	28	24
Average number of cows per association	777	626

The next tabulation forms a grand summary of results for all cows in New Zealand which were systematically tested during the last two seasons, on a lactation period exceeding 100 days, and for which we have figures:—

Table 2.

	1923-24.		1922-23.	
	Days.	Pounds Butterfat.	Days.	Pounds Butterfat.
Average of all cows (107,201 in 1923-24 and 50,683 in 1922-23)	230	212.75	226	233.82
Highest association average	255	302.86	273	311.47
Lowest association average	175	140.16	170	159.49
Highest individual herd	301	585.76	324	518.93
Lowest individual herd	120	57.25	141	64.06
Highest individual cow	300	780.12	..	739.41
Lowest individual cow	109	18.23	105	26.22
Average daily production of butterfat per cow	..	0.9247	..	1.0366

Comparing the two seasons, the most apparent fact is that the average yield in 1923-24 decreased by 21.07 lb. butterfat. This position must not be interpreted as signifying that our dairy cows are going back in quality. The rapid increase in herd-testing has naturally brought in a large number of new herds, and some of the associations which commenced last season are located in outlying and newly settled districts. This obviously must tend to reduce the average, as indicated by the results for the preceding year from a smaller proportion of newly established associations. Again, climatic conditions during the season 1923-24 were not as satisfactory as those for the previous season. There was a very dry period in late spring and

early summer, while in autumn serious floods occurred in several dairying districts. The important thing, however, is to get as many cows as possible tested, and then improved average production must follow as a natural sequence.

Taking out from the averages those associations which operated in 1923-24 for the first time, there remain seventy-four associations which have been running for at least two seasons. A comparison of results from these is probably a fairer way of comparing the average production of cows on test for the two last seasons. The position is as follows:—

Table 3.

Season.			Number of Associations.	Number of Cows.	Average Days.	Average Pounds Butterfat.
1922-23	..	..	74	47,172	225	232.65
1923-24	..	..	74	50,350	227	217.87
Differences in 1923-24			..	+3,178	+2	-14.78

On this basis, therefore, the difference is only 14.78 lb. butterfat.

In the following table are compared the yields for the same herds (Dairy Division associations only) on test during the two past seasons:—

Table 4.

Season.			Herds.	Cows.	Days.	Pounds of Butterfat.
1923-24	..	..	357	8,879	239	242.31
1922-23	..	..	357	9,017	247	246.46

This is perhaps the most useful comparison of all, and more accurately shows what improvement, if any, has been effected. In this case it will be noticed that the difference in average production for the two years is only 4.15 lb. butterfat. The difference in the average length of milking-period is, however, eight days, so that on a per-day basis these herds have improved in production.

SIGNIFICANCE OF LENGTH OF LACTATION PERIOD.

Referring again to the grand summary (Table 2), next to the fact of decrease in average production comes the question of the length of milking-period. It will be noted that for the 1922-23 season this was 226 days, and for 1923-24 230 days, an advance of four days. Under the various circumstances which are to be taken into consideration, this must be accepted as satisfactory. The writer has frequently expressed the opinion that the season of the average dairy cow in New Zealand is too short. This 230 days represent less than eight of the thirty-day periods into which the herd-testing association season is subdivided, which means that there are more than four months in which our average dairy cow is doing nothing in butterfat-production. During that period she requires bodily maintenance, and general charges bearing on the cost of the cow's keep continue much as during the milking-period. Two months' rest from milk-production should be sufficient.

If every one of the 151,214 cows on test in the Dominion last year had produced for ten months instead of for less than eight—that is to say, for 300 days instead of 230—what would it have meant in returns to the industry? Taking the records available for 107,201 cows tested last season, and assuming that the cows milked the extra two months and during that period produced in proportion to their average for the season, it is estimated that about 50 lb. of butterfat each would have been added, or a total of 5,360,050 lb. more butterfat. With butterfat at 1s. 6d. per pound, this is equal to £402,004, or, to each herd-owner, £105 5s. for the two months. But this is only for cows included in our averages. The longer lactation, if it applied to all the 1,184,977 cows in normal milk last season, would mean an astonishing additional sum.

Progressive dairy-farmers recognize that a prolonged milking-period is the outcome of breeding and feeding for the longer lactation period. First of all there must be a herd sire, which can best be chosen with regard to the results of the certificate-of-record testing of purebred dairy cows. The C.O.R. testing provides for a 365-day production. If it is proved that for several generations certain females can maintain their production for a whole year, then it is a reasonable assumption that by mating a bull from such dams with ordinary herd cows the average term of profitable lactation will in time increase. Dairy-farmers should fully realize that money spent in the purchase of a butterfat-record purebred sire is well invested.

SUMMARY OF 210-DAY RETURNS.

The Dairy Division officers have supplied returns on the basis of all cows in milk for not less than seven periods—that is, 210 days. A summary on this basis is interesting in that it more nearly shows what the average cow is capable of producing. It is, of course, necessary to know what each cow on test actually yields, and the 100-day summary supplies this want. It must be recognized, however, that many cows are for various reasons withdrawn or culled in the early stages of their lactation period. A cow may be sold or injured, or for some other reason be discontinued. Of the 30,773 cows tested by Dairy Division officers and eligible for inclusion in a return deleting all animals in milk less than 100 days, 20,208 qualified for inclusion in a 210-day summary. The tabulated results for this classification are as follows:—

Table 5.

				Days.	Pounds Butterfat.
Average of all cows (20,208)	..	..	..	265	257·16
Highest association average	..	..	..	297	338·93
Lowest association average	..	..	..	238	188·41
Highest individual herd	..	..	..	245	484·17
Lowest individual herd	..	..	..	240	109·15
Highest individual cow	..	..	..	311	633·26
Lowest individual cow	..	..	..	257	61·51
Average daily production of butterfat per cow	..	..	..	..	0·9709.

Compared with the previous season, this shows a decrease in average yield of 9·94 lb. of butterfat, and an increase in average lactation of 7 days per cow.

C.O.R. AND ASSOCIATION RESULTS COMPARED.

An interesting study lies in the comparison of results where the same cows were tested under both certificate-of-record and association system during the same season. Our earlier experience has again been borne out during the season under review—namely, that if samples and weights are carefully taken the association method will, on the whole, show results as accurate as are necessary. The C.O.R. system may be accepted as giving the highest degree of accuracy practicable, and therefore may be taken as the standard by which the results from other systems may be judged. Then again, the testing breeders of pure-bred dairy cows may be taken as the better-class dairymen, so that the cows would be well cared for, and the sampling and weighing of milk for the association would be carefully and conscientiously carried out.

Following is a tabulated statement of returns for last season, comparing results where the same cows were on both association and C.O.R. test:—

Table 6.

Cow.	Certificate of Record.		Association.		Difference in Butterfat.
	Days.	Butterfat.	Days.	Butterfat.	
		lb.		lb.	lb.
1	291	359·63	291	346·35	13·28
2	294	417·11	294	400·40	16·71
3	347	644·02	347	652·46	8·44
4	223	498·48	223	487·73	10·75
5	287	516·08	287	503·51	12·57
6	293	402·68	293	405·19	2·51
7	281	422·44	281	424·90	2·46
8	337	497·71	337	491·16	6·55
9	266	540·37	266	497·19	43·18
10	206	336·55	206	329·51	7·04
11	163	201·22	163	200·67	0·55
12	302	402·61	302	404·92	2·31
13	281	425·77	281	415·28	10·49
14	283	366·56	283	365·15	1·41
15	312	477·83	312	482·79	4·96
16	275	377·16	275	370·04	7·12
17	262	399·58	262	381·69	17·89
18	260	345·68	260	360·79	15·11
19	255	383·95	255	394·94	10·99

Summary.

Total cows	19	Average days (C.O.R. and association)	274
Total days (C.O.R. and association)	5,218	Average butterfat (C.O.R.)	421·86 lb.
Total butterfat (C.O.R.) ..	8,015·43 lb.	Average butterfat (association)	416·56 lb.
Total butterfat (association)	7,914·67 lb.	Average butterfat difference	10·22 lb.
Total butterfat difference ..	194·32 lb.	(Including plus and minus variations.)	

Average difference to average C.O.R. butterfat = 2·4 per cent.

It will be admitted that an average difference of 10·22 lb. butterfat on an average C.O.R. yield of 421·86 lb., or 2·4 per cent., affords proof of the practical reliability of the herd-testing association system.

THE MOVEMENT BY DISTRICTS.

The following table, based on the official agricultural and pastoral statistics taken as at 31st January, 1924, indicates how the herd-testing movement is represented in the various land districts, also in the North and South Islands:—

Table 7.

Land District.	Total Number of Cows in Milk and Dry, 31/1/24.	Total Number of Cows in Milk, 31/1/24.	Total Number of Cows tested, 1923-24.	Percentage of Cows in Milk and Dry tested.	Percentage of Cows in Milk tested.	Number of Associations or Groups.	Average Days in Milk.	Average Yield of Butterfat.
								lb.
North Auckland	197,324	174,965	15,102	7.65	8.63	15	206	186.24
Auckland ..	314,077	288,903	72,404	23.05	25.06	63	234	208.78
Gisborne ..	30,961	26,328	3,082	9.95	11.71	6	209	202.16
Hawke's Bay ..	54,233	46,880	4,391	8.10	9.37	8	231	228.34
Taranaki ..	203,560	192,220	18,567	9.12	9.66	39	233	246.66
Wellington ..	204,645	184,450	30,584	14.94	16.58	37	237	215.60
North Island ..	1,004,800	913,746	144,130	14.34	15.77	168	231	213.29
South Island ..	307,789	271,231	7,084	2.30	2.61	20	194	197.47
Dominion ..	1,312,589	1,184,977	151,214	11.52	12.76	188	230	212.75

NOTE.—The two last columns of this table do not refer to the total number of cows tested, but to the number for which figures are available. The numbers represented in these averages are: North Auckland, 9,489; Auckland, 54,458; Gisborne, 2,026; Hawke's Bay, 1,790; Taranaki, 13,377; Wellington, 22,402; North Island, 103,542; South Island, 3,659; Dominion, 107,201.

THE "GROUP" SYSTEM.

A passing reference may be usefully made here to what is commonly known as the "group" system of herd-testing. This term refers to those associations or dairy companies which engage independent testing officers to visit the farms and take samples and check milk-weights, this usually being done for one day in each thirty days. The cost is necessarily higher than for a method which requires the association member to record his own weights and take his own samples, and the tests may reasonably be expected to evidence more variation from period to period. But there are advantages, among which may be mentioned the fact that the member is relieved of the taking of the milk-weights and milk-samples (which some dairy-farmers consider tedious); some also consider the results more satisfactory on account of their being derived from an independent person.

Last season 43,144 cows were tested on the group system in thirty-four groups, and represented 40.2 per cent. of the cows tested by other than Dairy Division officers. It is a scheme of comparatively recent adoption, but its suitability to certain classes of dairy districts has been well demonstrated. Among the principal groups are those controlled by the New Zealand Co-operative Dairy Company, Hamilton, the first company in this country to try the scheme. Last season it operated twenty-five groups, embracing 32,081 cows.

NOTE.—Thanks are due to those engaged in herd-testing work who supplied annual summaries of results for associations under their control.

IRRIGATION AND ITS PRACTICE.

(Continued.)

V. DRAINAGE.

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GENERAL CONSIDERATIONS.

FROM the references previously made to this subject it will have been realized that drainage, either natural or artificial, is vital to successful irrigation, and most especially to its continued success.

Drainage does not mean merely the removal of excess water from the surface of the land. Such should not generally be necessary on irrigated land if properly graded and not overwatered. It may occur occasionally that irrigation-water will accidentally escape and lodge on the surface of depressions in quantities which would take too long to disappear through the soil. Facilities must be provided for such surplus water to readily run off in surface drains to some place where it will do no harm; but as the provision of such surface drains is obvious and so easily effected there appears no reason to discuss that phase of the question further.

The real meaning of irrigation drainage is sub-drainage, whereby the natural water-table or ground-water level will be prevented from rising too near the surface. In other words, "gravitational" water must not accumulate in the soil, but must be permitted to flow away through the subsoil and eventually find its way to some river or freely flowing stream.

It has been previously pointed out that only capillary water is directly useful to plant-life. From a point of view of economy of water-usage only the ideal practice would be to apply water in just such quantities as would be held in suspension (by capillary attraction) in the few usable feet of soil-depth. If this were possible in actual practice no sub-drainage would be necessary. It is, however, now generally recognized that, even with the most up-to-date methods, it is a physical impossibility to prevent some gravitational water from passing into the deeper layers of the subsoil. Some American writers assert that as much as one-third of the water applied will find its way down by gravity and have to escape through sub-drainage. This will no doubt vary with conditions, but it can safely be accepted that in order to apply enough water to keep a sufficiency of capillary water available throughout the whole of the growing season a very considerable wastage must occur. It must be remembered that this wastage occurs not over the surface of the ground but *through* the soil, and must escape from *underneath* the fields.

It is here appropriate to state that another feature comes in besides the matter of economy of water-usage, and it is now recognized that it is just as well for the soil that a slight wastage of water should pass through it. To explain this in a very simple manner let us imagine a bucket filled with soil, to the surface of which small quantities of water are added each day. All water (other than distilled or rain water)

may be expected to contain minute solutions of injurious salts. If the quantities of water added each day are so small as not to soak to the bottom of the bucket before being held by capillarity and later evaporated, then it is only a matter of time (it may be many years) when the accumulation of all the injurious salts left behind by the evaporating water will render the land sterile. In addition, any initial small quantities of salts which may have been distributed throughout the soil will be brought near the surface and be more harmful through being concentrated. However, let us increase the applications of water, so that each time a little soaks right to the bottom of the bucket and escapes through a hole provided there. Since water is capable of carrying a very heavy solution of these injurious salts, an extremely small quantity escaping from the bottom of the bucket will carry away, in heavy solution, the salts brought in by all the water applied. It will, of course, also carry away a certain quantity of valuable plant-foods, but nature is tending always to replace these, and, in any case, if the land is productive the farmer can afford to replace them artificially. The water which escapes may be regarded as the gravitational waste water from irrigation, and the hole in the bottom of the bucket as the sub-drainage system which must be under the ground to take it freely away.

Thus it will be seen that a certain small waste of water is essential to the preservation of the continued productiveness of the soil, but the latter must have drainage. Over-irrigation by itself will never cause accumulation of alkali, and will actually tend to reduce the alkaline content of the soil; but if accompanied by lack of sub-drainage, then, of course, the more water applied the more alkali will be added to the soil.

These remarks must not be taken as an excuse for over-irrigating fields which happen to possess a free natural sub-drainage. Deliberate over-irrigation is bad practice from every point of view, and particularly because it will leach the soil of its valuable plant-foods. If the irrigator endeavours by the most efficient methods to reduce his water-usage it will still be found that sufficient will gravitate through the soil to carry off alkali.

If natural drainage exists through a deep, free subsoil, then no drainage problems will exist, and, as already stated, this is fortunately the position with respect to the majority of the irrigable lands of Central Otago. However, if natural drainage does not exist, deep canals and drains must be provided to draw off surplus water and thus keep the ground-water level down, so that there may be a slight downward waste of water through the usable upper layers of the soil immediately after each irrigation. It is recognized as the business of the irrigation engineer to satisfy himself as to the natural drainage facilities of the soil, and, where these are not adequate, to make provision for a system of main drainage canals. In order to draw down the general water-table and allow for a subterranean gradient in the ground-water under the adjacent fields, these main canals may have to be fairly deep—10 ft. or more is not unusual.

As an alternative to low-level gravity canals, in some parts of America drainage is being effected by pumping from deep wells sunk at fairly wide intervals throughout the affected areas. These wells collect the ground-water, which, when pumped from them, is either

used again for irrigation or carried away in shallow surface canals. This method would not generally recommend itself in circumstances where the method first described could be provided at reasonable cost, and the writers do not consider its use likely to be warranted in any part of Central Otago.

The waste gravitational water usually takes some time to work down into the water-table of a valley-bottom, and it may therefore occur that the maximum inflow to the general water-table will lag some weeks or months after the period of heavy irrigation. Also, during the warmer period of the year, owing to heavy evaporation from the land, less waste water will go to drainage. On account of these two conditions the ground-water level, if not controlled, is likely to be much higher during the non-irrigating period. In actual practice it is desirable to reverse this state of affairs. This may be readily done by providing lock-gates at intervals in the drainage canals, by manipulating which the land may be deeply drained in winter-time, and have the water-level brought up to within a few feet of the surface in the summer. To guide the operators in the control and regulation of the ground-water level, a series of permanent inspection-pipes should be placed about the affected area. For this purpose perforated pipes may be driven into the ground at occasional points, so that by taking soundings therein the exact water-level may be ascertained from time to time.

In a former article of this series (April last) a warning was given against the dangers of over-irrigation combined with insufficient drainage. It may be added that irrigation of any sort, even under-irrigation, will eventually cause the same damage to the soil if free natural or artificial sub-drainage does not exist. It is, however, fair to state that the irrigator is sometimes blamed for over-irrigating when the cause of the trouble should have been attributed mainly to lack of drainage. In parts of America this fact has only recently been fully realized, after much damage has been done and many settlers ruined. When lands under irrigation deteriorated the one cry was "over-irrigation." In some cases that may have hurried on the destruction, but it is now being asserted by recognized high authorities that very often the cause was simply the continuance of reasonable irrigation practice on lands which had not sufficient sub-drainage facilities, and this assertion is supported by scientific proofs. Many of these American irrigation projects were developed by companies for speculative purposes, without full enough investigation of the natural drainage facilities of the soil. The result was that allowance was not made in the rental charges to settlers to cover the cost of unanticipated drainage systems. When drainage troubles arose, requiring extensive remedial measures, the companies would not face the position, or, remaining ignorant of its true cause, blamed the settlers for over-irrigating. The latter on their part could not deal with it, and thus some settlements gradually became complete failures through the accumulation of alkali. Steps are now being taken in some cases to again reclaim these areas. Adequate deep drainage has to be provided, and then excessive irrigation actually resorted to for the purpose of washing the injurious salts through the soil and conveying them away in the drainage-water.

In the only existing scheme in Central Otago where sufficient natural drainage is not present—that of Ida Valley—the position was realized

by the Government at the outset ; in fact, in this case portion of the valley-bottom was already in need of drainage before irrigation commenced. A drainage system for the valley was laid out several years ago, but the owners of the low-lying lands were afraid of being over-drained. It is only now, after a few years of irrigation, that these farmers are likely to view the question of drainage eye to eye with the Government, and thus facilitate the installation of adequate drainage canals.

It is anticipated that generally, in those Central Otago lands which require artificial drainage, the provision of the main canals will suffice without any further work within the individual fields ; but if not, then the farmer must give the surplus water under such fields quicker access to the main canals by providing subsidiary drainage. This can be effected by resorting to one or other of the methods here described.

FIELD-DRAINAGE METHODS.

Open Ditches.

Open ditches dug to a depth of 2 ft. to 3 ft. and of varying width are very often utilized for draining farm-land. On some soils, such as peats, this system is the only practicable one, on account of the manner in which such soils consolidate and sink from year to year. As described later, open ditches also are very effective in cutting off water which has been brought to the surface by an outcrop of hard-pan. Drains of this nature are, of course, much cheaper to construct than under-drains, but they have certain disadvantages which mitigate against their practical utility. The chief of these is the fact that they occupy a portion of the land in such manner that it cannot be utilized, and also render the construction of culverts necessary to permit of farm traffic. The cleaning-out of such ditches becomes a costly and recurring undertaking, and it frequently happens that this cleaning is neglected, thus encouraging the growth of weeds, which, if allowed to grow unchecked, quickly spread over the adjacent land. The damage by stock to the banks is also a source of trouble, and stout double fencing may be necessary in order to prevent their slipping into a deep ditch from which they may be unable to extricate themselves.

While the Central Otago irrigation farmer may in certain cases find it an economic proposition to dig a number of open ditches in certain portions of his farm, generally speaking it will be a more efficient and profitable undertaking to provide those fields requiring drainage with a proper system of under-drains.

Tile Drains.

The most satisfactory and permanent system of under-drainage which can be adopted is undoubtedly that of using unglazed porous clay tiles.

An outlet, such as a creek or drainage canal, is the first essential for carrying off the surplus water. Having secured a suitable outlet, the next important consideration is the grade of the ditch. This will, of course, be regulated by the fall of the land, but it should be borne in mind that a grade of 1 in 500 is the least permissible in

an ordinary tile drain. A greater fall than this, however, can usually be obtained, and it is desirable that a good fall should be allowed for, so that comparatively small and relatively cheap tiles may be utilized. If a fall of 2 in. or more in 100 ft. can be obtained the conditions may be regarded as quite favourable for successful results. It sometimes happens that a smaller fall has to be accepted, but this should be only after careful levelling has proved a greater one impracticable. In some instances the line of lowest ground is quite tortuous, making the distance from highest to lowest point greater than if following a straight line. In such a contingency and where the fall is very small it may be desirable to excavate to a greater depth in places, cut off bends, and so obtain an increase in the fall.

Speaking generally, it may be accepted that the main drain should follow the lowest line in order to secure as great a fall for the laterals as possible. The laterals which lead into the main drain on either side

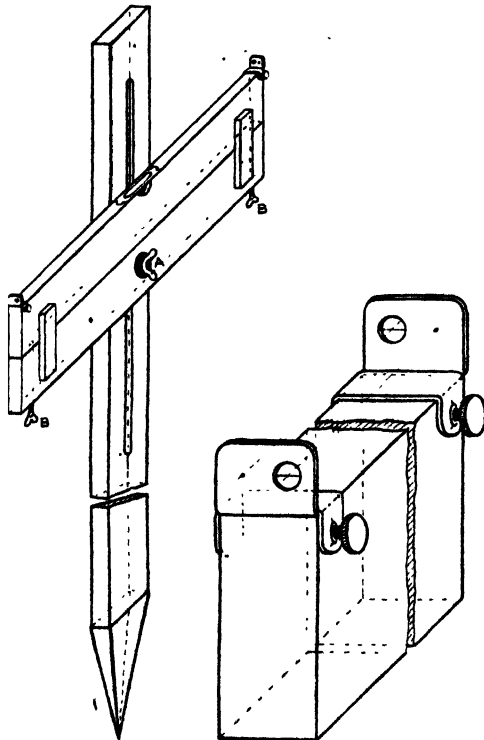


FIG. 1. DEVICE FOR TAKING DRAINAGE LEVELS WITH A CARPENTER'S LEVEL FITTED WITH PEEP-SIGHTS.

The slotted stake is driven into the ground, and the level roughly adjusted and clamped into position by screwing up at A; for finer adjustments the thumb-screws at BB are used. The right-hand drawing shows the peep-sight arrangement on a larger scale.

should be so arranged that no two will join the main drain opposite one another; and where they do join the main they should be acutely angled, so that the discharge from the lateral will to a certain extent be directed in the same direction as the flow in the main drain. This will prevent the water in the main drain from backing up into the laterals and thus preventing the proper drainage of that portion of the field.

The utmost endeavour should be made to get a perfectly level fall for the whole main and in the whole length of each lateral, and when the tiles are laid the greatest pains should be exercised in laying them perfectly true to the grade. Where this is done, and the ends of the tiles are brought close together, there is little likelihood of much sediment lodging in the drain. Before digging any ditches it is necessary to map out the course of the main drains and chief laterals. This can best be ascertained by the use of a proper level and graduated staff, taking readings from pegs driven into the ground about every 100 ft. apart along the proposed course of the drains. By this means the fall of the land can be ascertained over different sections of the ground, and the grade most suitable for that particular main or lateral can be fixed upon. Many home-made devices have been quite successfully used for taking drainage levels, such as a carpenter's level adapted as shown in Fig. 1, but great care must be exercised in using them if true levels are to be obtained.

Where the grade or fall of the drains has been decided upon by aid of a level, it remains to dig the ditch to the grade in question. A simple method of doing this is by the use of what is termed a span-level or triangle (Fig. 2). To construct this three narrow strips of board are required, each about 6 ft. in length; these are nailed together in the form of the letter A, the span being exactly half a rod. From a pin at the top a plummet is suspended. The span-level is then placed, for the purpose of marking, upon a floor or piece of timber, which must be perfectly level, and the place where the plumb-line touches the cross-bar is marked; one foot is then raised $\frac{1}{4}$ in., and the place where the line touches the cross-bar again marked, and this will show a rise or fall of $\frac{1}{8}$ in. to the rod. These markings can be made to any extent desired, and by dropping the instrument into the drain occasionally it will show if the drain is dug with a uniform fall and precisely that determined on at the outset of the digging operations.

Another method of obtaining the same result is known as the overhead system. In this method a number of cross-pieces are erected at short intervals, as shown in Fig. 3. The first cross-piece is driven in either at the outlet of a main drain or where a lateral meets a main drain. This peg is driven in so that the cross-arm is at a height of, say, 2 ft. above the level of the ground, and the arm is then trued up by a spirit-level. The next peg to be driven in will have its cross-piece exactly that number of inches higher than the first cross-piece that there is in the fall or grade of that particular section. This will be the case with each peg driven in at regular intervals along the proposed ditch. When a sufficient number of cross-pieces have been accurately driven into position a line is then drawn tightly over the arms. With this line as a guide no difficulty will be experienced in digging the ditch to a required depth. If the depth



FIG. 2. SPAN-LEVEL. (SEE OPPOSITE PAGE.)

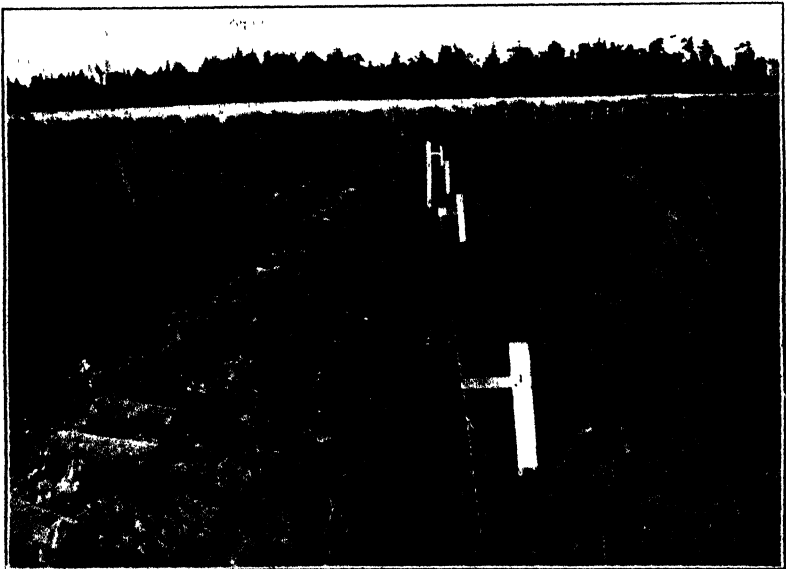


FIG. 3. OVERHEAD SYSTEM OF OBTAINING DRAIN-LEVELS.

of the ditch is to be, say, 3 ft. a measuring-stick 5 ft. long will be required, and no difficulty will be experienced in digging the bottom of the ditch 5 ft. from the line in the cross-pieces.

It is not always practicable to maintain a ditch at a constant gradient, and where such is the case it is advisable to change from a less fall to one which is greater. By doing this any sediment carried in the upper part of the drain will also be carried in the drainage-water when the fall is increased. With reverse conditions, silting of the drains would probably occur.

The digging of a drain-ditch requires considerable skill if it is to be done properly, and proper draining-spades and tile-laying tools are necessary for the purpose.

It is impossible to give specific directions for selecting the sizes of tiles which are most suitable, except where all details regarding the land to be drained are known. The size of the main-drain tile will vary from 6 in. to 12 in., according to the grade. It will be appreciated that where the grade is slight or the catchment area large the diameter of the tiles must be proportionately large. The quantity of water which the drains have to carry will also be an important factor in determining the size of tiles. In actual practice for Central Otago conditions it will be found that 3 in. tiles for laterals and 6 in. tiles for mains will most generally be adopted. The use of tiles less than 3 in. diameter is not to be recommended, on account of their liability to become silted up. The distance apart at which to lay drains varies according to the nature of the soil and the amount of water to be removed. Generally speaking, the drains will be about 40 ft. apart in heavy soils and nearly double that distance in lighter soils. In depth the drains will vary from 2 ft. 6 in. in heavy soils to 5 ft. in lighter soils.

In these short notes on tile drainage only an indication is given of the procedure to be adopted. Settlers who intend draining portions of their farms are recommended to become thoroughly acquainted with the best manner of carrying out the work, either by consulting one of the many books dealing specifically with the subject, or, better still, by assisting an experienced drainer in actual drainage operations.

Stone, Scrub, and Box Drains.

Apart from tile-draining, there are a number of other methods of carrying out under-drainage by the utilization of various materials. Some of these may be briefly noted as follows:—

Stone drains: Stone drains are formed in two ways, one of which consists of placing stones in the bottom of the ditch so as to secure a clear watercourse. The other method is to partially fill the drain with small stones, allowing the water to find its way between them. In portions of Central Otago there is an abundance of suitable stone for drains of this nature, the flat slabs of mica-schist being particularly adapted for such a purpose. A good water-way may be obtained either by placing a stone on each side of the bottom of the drain and laying a flat stone upon them, or by setting a flat stone upon edge on one side of the drain and leaning



FIG. 4. WOODEN BOXES FOR UNDER-DRAINING.

another flat stone against it from the other side. In either method care should be taken to cover well with more stones all the spaces through which sand or earth might pass to obstruct the drain. In this manner many troublesome stones on the farm can be disposed of to great advantage. Drains of this nature, however, have the great disadvantage that they are liable to become choked up with silt, and in the course of time will require relaying.

Scrub drains: In some districts under-drains are often constructed by placing bundles of good-sized manuka in the bottom of the ditch, which is then covered in with soil. In Central Otago, however, scrub of any nature is absent.

Box drains: Another type of drain is constructed by means of A-shaped wooden boxes with two sides, the latter being held together by light cross-pieces at intervals (Fig. 4). When durable timber is used, drains of this type may last for a considerable period of years.

Dealing with an Impervious Stratum.

In the foregoing notes it has been assumed that the soil is homogeneous to the full depth required from the surface to the safe ground-water level. If, however, a stratum or pan of impervious material exists between the surface and the general water-table quite a different problem arises. If the pan is very near the surface, but cannot be permanently broken up to pass a little drainage-water, the land will be quite unsuited to irrigation, unless on a decided slope. In the latter case the drainage will travel down the slope on the pan, but care must be taken that at some lower part of the slope the accumulated drainage from the pan does not become so excessive as to saturate the whole of the overlying soil and come out on the surface.

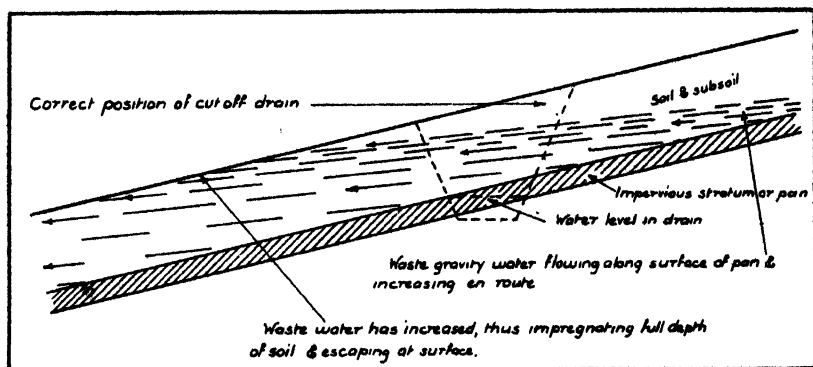


FIG. 5. SKETCH SHOWING METHOD OF CUTTING OFF SUB-DRAINAGE FROM UNDERGROUND IMPERVIOUS STRATUM ON SLOPE.

[Original.]

This condition can be remedied by cutting a drain across the slope of the land just before where the drainage-water would come out on the surface (Fig. 5). The drain should in this case be cut deep enough so that the water surface in it will be below the top of the impervious strata and thus effectively cut off the onflow down the slope. For ascertaining the depths and correct locations for such drains, preliminary inspection holes must be dug or bored with a post-hole borer. If desired, the open drains in this case may be replaced by buried tile drains or stone filling situated where the bottom of the open drain would have been.

(To be continued.)

METAL-BOUND BUTTER-BOXES.

THE article entitled "Butter-boxes and their Design," published in last month's *Journal*, has attracted considerable attention. As permission has been granted to several dairy companies to make experimental shipments of wire-bound butter-boxes this season, a number of inquiries have been received regarding the use of wire bindings in place of flat metal straps.

The wire-bound box which is being allowed for shipment requires $\frac{3}{4}$ in. sides, top, and bottom, and $\frac{1}{2}$ in. ends, with at least five nails per nailing-edge. In confirmation of the statement which appeared in last month's article to the effect that the ends were the weakest parts of the box and might require to be completely redesigned, advice has since been received from Britain that $\frac{3}{4}$ in. ends are advisable. At least two wires of the largest size which can be efficiently applied by the system used should be employed, located similarly to the flat metal straps.

While this wire-bound package is slightly stronger than the old type of package, it should be realized that it is less satisfactory than the flat metal-strapped package already specified. This is due to the fact that the wire binding is not capable of maintaining the tension in the metal as well as the flat strapping, and the binding may therefore hold the package together merely as a bundle. In the first place, the wires cut so badly into the edges of the box that the tension given by the springing of the sides is soon lost. Secondly, where the system uses a joint made by twisting the wires together it is usual to employ annealed metal, which is much weaker than unannealed metal, and is also liable to stretch considerably and so relieve the tension in the wire.

THE GROWING OF ELECTRIC-TRANSMISSION OR TELEGRAPH POLES.

TREE SPECIES RECOMMENDED FOR FARM FORESTRY.

H. A. GOUDIE, Conservator of Forests, Rotorua.

THE past five years may be regarded as epochal in the history of forestry in New Zealand. During that time there has been a remarkable, widespread public interest in the subject; five million trees have been distributed from the State nurseries and planted mainly by farmers, and there is an insistent demand for information regarding the respective merits of the introduced trees. The necessity for and the advantages of planting the waste places on a farm with trees seems to be now more generally understood, and if the present enthusiasm is maintained and directed along sound lines the results will be highly profitable to the individual farmers and to the Dominion as a whole. While the primary object may be to obtain shelter for buildings and farm-animals, it cannot be too often reiterated that this object can be attained, in the majority of cases, just as well with the valuable timber-yielding species of trees as with those having a shelter value only. Admitting the truth of this statement, then the object becomes twofold, and it only remains to choose a species of tree which will produce the class of timber required.

In the notes which follow upon the various trees suitable for the production of poles the writer has had in mind the great development which has taken place in the production and use of electricity both for lighting and power purposes, and the very large demand likely to exist in the future for poles for the extension of this work and for renewals. So far as it is possible to judge, a crop of poles upon maturity should be highly remunerative. The existing power-lines and those contemplated within the near future are estimated to require forty thousand poles per year for renewals, the value of which may be set down at £100,000. Outside of this, the extension and renewals of telegraph and telephone lines which has to be provided for indicate an extensive demand for timber of this class. In short, it may be safely assumed that, as the readily available supply of our native timbers becomes reduced, any timber, particularly the strong and durable kinds, will become valuable.

EUCALYPTS.

The main qualifications required of a pole are strength and durability. For high-tension electric-transmission poles these qualities are of the greatest importance, because of the high cost of renewing decayed poles and the great danger to life which would result should the line break down. For these reasons it is customary to use poles of the highest quality, and on most of the high-voltage lines throughout New Zealand Australian ironbark poles of the following species have been used: Grey or white ironbark (*Eucalyptus paniculata*), broad-leaved ironbark (*E. siderophloia*), narrow-leaved ironbark (*E. crebra*), and red ironbark (*E. sideroxylon*). For telegraph-lines and electric

reticulation work the factor of safety required is considerably lower; smaller poles may be used, although durability is as desirable a quality as in the high-voltage lines. The qualities of strength and durability are found combined in some of the eucalypt timbers more than in any timber in general use, and therefore they may be regarded as having first claim to attention in this article. An endeavour has been made to deal with the species here described in their order of merit.

IRONBARKS.

The ironbark group have hard, rugged, and furrowed bark. The presence of small grains of resin give it a gritty feeling when rubbed between the fingers. It contains practically no fibres, and can be readily pulverized.

Eucalyptus paniculata (White or Grey Ironbark).—The habitat of this, the strongest of the ironbark timbers, is chiefly the coastal districts of New South Wales and southern Queensland. It is generally found growing on ridges and on dry, poor land. It is usually a tree of medium size—60 ft. to 70 ft. in height, with a diameter of 2 ft. to 3 ft.; occasionally larger specimens are found. Ironbark has been described as "the king of New South Wales hardwoods" from the fact that it is excelled by no other timber in Australia for combined strength and durability. It is extensively used for bridges, railway-sleepers, vehicle-construction, warehouse buildings where large strong beams are necessary, poles for telegraph and electric-transmission lines—in short, for any purpose where durability and great strength are needed.

The white ironbark can be recommended for growing only over a comparatively restricted area in the warmest parts of New Zealand. Good specimens may be seen in the old Wesley College grounds, Three Kings, Auckland, where they were planted by the Rev. J. H. Simmonds. At Puhipuhi Plantation, in the Whangarei district, at an altitude of 1,200 ft., ironbarks have been disappointing, which seems to indicate that this species prefers warmer, less exposed sites at a lower altitude. The species has also been found in the colder parts of the Waikato district and as far south as Tarukenga, on the Rotorua line, but in every such case the trees are stunted and of no commercial value. Although the evidence available is certainly not large, it may be safely assumed that this species can be satisfactorily grown to merchantable-timber size in warm sites in the upper Waikato, North Auckland Peninsula, Bay of Plenty, and probably Hawke's Bay. Its high value as a timber makes it well worth experimenting with in the districts mentioned.

Eucalyptus sideroxylon (Red Ironbark).—The habitat of this species is in New South Wales, Queensland, and the northern part of Victoria, but it is much more widely distributed than *E. paniculata*, occurring beyond the Blue Mountains and in the interior. It is usually found on poor, sterile ranges. It attains a height of 100 ft. and a diameter of 4 ft., though usually it is much smaller. The timber is used for purposes similar to those given for the white ironbark, from which it differs chiefly in having darker and less strong timber. The red ironbark appears to be less intolerant of cold than the white species.

Good trees have been observed at Cambridge, in the Waikato district, and good specimens are fairly common in the upper Waikato generally. It can be recommended for planting in the districts mentioned for the white ironbark.

Eucalyptus siderophloia (Broad-leaved Ironbark).—An inhabitant of the coastal ranges in New South Wales and Queensland, where it becomes a large tree of 100 ft. in height and 4 ft. in diameter. It has not as good a reputation for durability as the white ironbark, but the timber is extensively employed for the same purposes. The writer has not come across any specimens of *E. siderophloia* growing in New Zealand, but is of opinion that it is likely to prove satisfactory if planted in the districts recommended for the white ironbark.

Eucalyptus crebra (Narrow-leaved Ironbark).—This species is widely distributed throughout New South Wales and Queensland, and generally attains dimensions similar to those of the broad-leaved ironbark. It has a strong and durable timber. The only experience the writer has had of this tree in New Zealand is with specimens planted at Puhipuhi, where its growth was slow and generally unsatisfactory. It is likely to succeed only in the warmest parts of the North Island.

BOXES.

The group of eucalypts known as "boxes" have a fibrous bark, generally light grey in colour, compact, with the furrows only moderately deep. In Australia the boxes are generally regarded as second only to the ironbarks for strength and durability. Any of the two species here mentioned can be successfully grown in the warmer parts of the Auckland, Bay of Plenty, Poverty Bay, Hawke's Bay, and Taranaki districts.

Eucalyptus hemiphloia (White or Grey Box).—Occurs in Queensland, New South Wales, Victoria, and South Australia, from the coastline away into the dry interior. Grows from 60 ft. to 80 ft., with a diameter of 1 ft. to 2 ft. The timber is tough, hard, cross-grained and not easily split, and very strong and durable. Used for railway-sleepers, poles, piles, girders, coachbuilding, &c. The only place in New Zealand where it has been observed growing is near the Town of Whangarei, where it is not only thriving but regenerating freely from seed.

Eucalyptus gonicalyx (Mountain-gum).—Found in the mountainous parts of Victoria and New South Wales, where it sometimes becomes a large tree of 200 ft. in height. Timber strong and durable, suitable for bridge-building, girders, poles, dray-shafts, and similar purposes. Good specimens have been found growing in the Foxton, Putaruru, Rotorua, and Matamata districts. It is, however, somewhat slow-growing in these parts, and is better suited for the warmer districts previously mentioned.

STRINGYBARKS.

The barks of this group have strong, long fibres, which intertwine and cross-lattice, forming more or less deep furrows, and are generally light grey in colour.

Eucalyptus eugenoides (White Stringybark).—In Victoria, New South Wales, and Queensland this species is found chiefly in the

mountains. It grows to a medium size, rarely exceeding 80 ft. in height. The timber, which, when dry, is of a pale reddish-brown colour, is used for fencing, railway-sleepers, street-blocking, and general building purposes. It is much softer and more easily worked than ironbark, yet is strong and durable. This species is commonly found throughout the Waikato, and has proved hardy in warm sites at

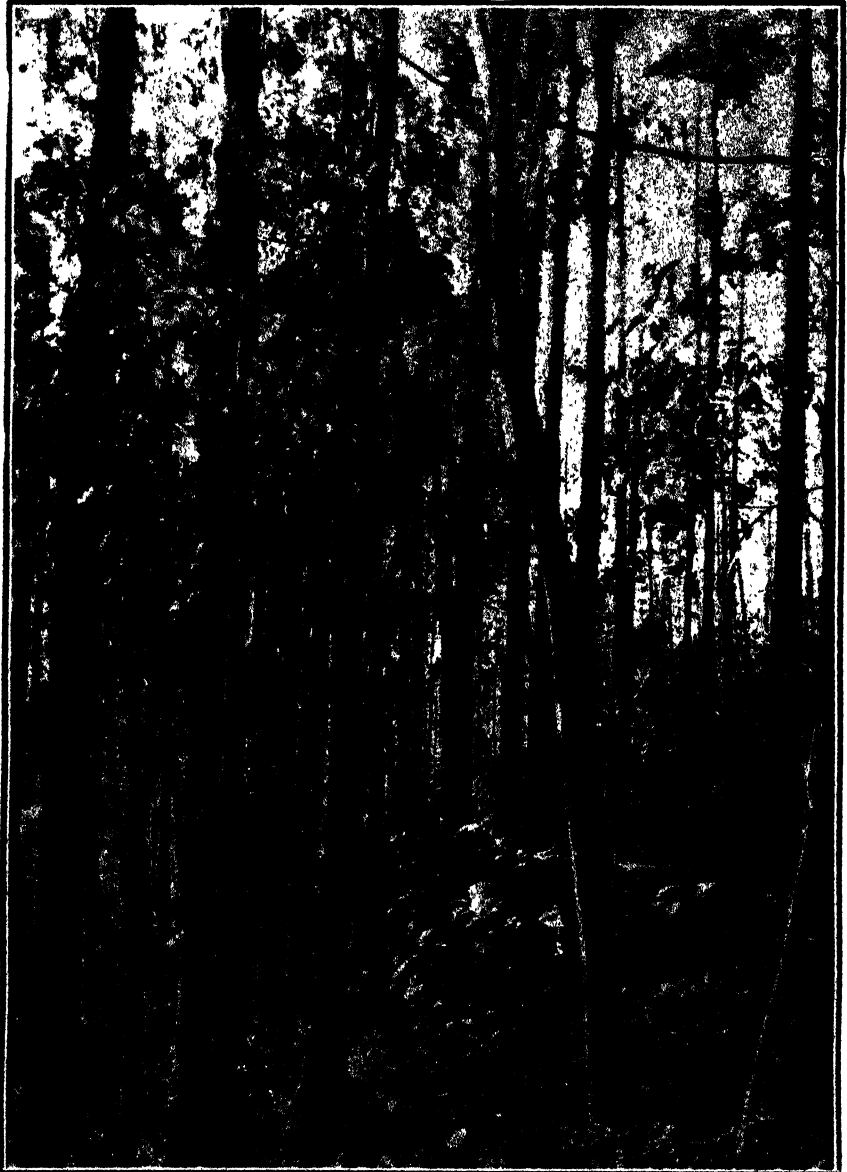


FIG. 1. A FINE PLANTATION OF STRINGYBARKS.

Rotorua. It is not a large-growing tree, and is generally found in ideal pole dimensions—a small girth and gradually tapering trunk free of large branches. Many instances might be quoted regarding the durability of the New-Zealand-grown white stringybark. It has given most satisfactory service as fencing-posts. Electric and telephone poles erected at Horotiu are still giving good service, and a flagpole erected at the Leamington School many years ago is still in a sound state. All evidence available goes to show that the durability of this timber is a well-established fact. It makes heartwood early in life, and, although a comparatively slow grower, its value as a pole timber cannot be questioned. It is hardier over a much wider range than any of the ironbarks, and will probably be found suitable for growing in any part of the North Island except the coldest and most exposed districts. In the South Island it will probably succeed in the warmer parts of Nelson and Marlborough.

Eucalyptus Muellieriana (Yellow Stringybark).—A tree of the mountains in South Australia, Victoria, and New South Wales, where it attains fairly large dimensions—80 ft. to 100 ft., with a diameter of 3 ft. Australian experience goes to show that this species produces a strong and very durable timber. It is extensively used for general building purposes, fencing, and wharf-construction. The yellow stringybark is not frequently met with in New Zealand, the writer's experience being confined to specimens found growing at Tauranga and at Rotorua. Like the white stringybark, this tree grows to ideal pole dimensions, but it is apparently more susceptible to cold conditions than that species. It may with certainty be recommended for planting in the warmer parts of the North Island. No information regarding the qualities of the New Zealand product is available.

VARIOUS SPECIES.

In the foregoing descriptions only those species which by their natural habit of growth produce well-proportioned poles have been dealt with. There are many other species of eucalypts, however, which produce durable timbers—in fact, the heartwood of most species is durable in contact with the ground, and most of them are strong timbers. Some of these, while fulfilling the conditions regarding strength and durability, make a large girth-growth and produce a log which could be converted into a pole only by sawing or hewing down to the right proportions. Climate and soil conditions, however, have a considerable influence upon the growth and shape of a tree, and where these conditions are such as to make the rate of growth slow a tree may produce a satisfactorily proportioned trunk to fit it for use as a pole. The species hereunder described are recommended for pole-growing, subject to these reservations:—

Eucalyptus pilularis (Black-butt).—Found in the coastal districts of New South Wales, Victoria, and Queensland. This is one of the largest of the eucalypts, a tree with a height of 156 ft. and 23 ft. girth having been recorded. The timber is strong, durable, and largely used for house and ship building, bridge-planking, wood-paving, and railway-sleepers. The species has not been planted to any great extent in New Zealand, but flourishing specimens have been found at Karaka (Auckland) and at Napier. It is somewhat tender

in the seedling stage, and strong plants should be employed when planting. It can be recommended for planting in the warmer and least exposed parts of Auckland and Hawke's Bay Provinces.

Eucalyptus saligna (Blue or Flooded Gum).—Confined to New South Wales and Queensland, where it is a coastal and coastal-range tree. Size, 150 ft. high and 3 ft. to 4 ft. in diameter. The timber has a reputation for durability and strength, and is extensively used for general building purposes, ships' planks, and felloes for wheels. Many fine specimens of this tree are to be found in the Waikato district, in the vicinity of Hamilton. It has also been noted growing well at Auckland, Whangarei, Thornton (Bay of Plenty), Levin, Bull's, and in warm sites at Rotorua. It appears to be slightly less susceptible to cold than *E. pilularis*, and, as will be seen from the places where it has been found growing, it is likely to succeed over a fairly large range in the North Island.

Eucalyptus botryoides (Bangalay).—Confined to eastern and south-eastern Australia; not occurring far from the sea. A smaller-growing tree than *E. saligna*, and much like that species in appearance, except that, whereas the former has a smooth bark, this has a thick rough bark, red in appearance, and much like that of the Californian redwood. The timber is light red in colour and durable. The species will grow in the same districts as those recommended for *E. saligna*.

HARDIEST SPECIES.

The undermentioned species are included because of their ability to withstand cold conditions and their probable usefulness in parts of the South Island.

Eucalyptus Gunnii (Cider-gum).—This is indigenous to Tasmania, and is a somewhat small-growing tree, 60 ft. in height, with a diameter of 2 ft. Tasmanian authorities describe the timber as pale-coloured and very hard and heavy, but not quite so hard as that of the white ironbark. *E. Gunnii* is probably the hardiest species of eucalypt introduced into New Zealand. It is a fairly common tree in Southland, where it has withstood the cold much better than the common blue-gum. It has also succeeded well in the State plantations at Waiotapu, where winter temperatures as low as 15° F. are not uncommon. The tree grows to good pole dimensions, and can be recommended for planting in the colder parts of New Zealand where other species of eucalypts cannot be grown.

Eucalyptus Macarthurii (Camden Woolly-butt).—So far as is yet known, the habitat of this species is confined to New South Wales. It frequents medium-cold localities, its usual range being from 2,000 ft. to 3,500 ft. altitude; prefers wet or low-lying land, or to follow the course of a stream. Height, 40 ft. to 80 ft.; diameter, 3 ft. to 4 ft. In its native home this species is not seriously regarded as a good timber-tree, and it is planted only for the production of the valuable oil contained in its leaves and young bark. Experience in New Zealand has shown that this species is well worthy of cultivation. In suitable localities it quickly grows into a large tree, sometimes over 100 ft. in height, with a diameter of from 3 ft. to 4 ft. The durability of the timber has been well proved. At Cambridge the

writer has seen miles of fencing constructed with posts split from twenty-year-old trees which still are sound after twenty-five years' service. Heartwood is formed early in the life of the tree, and consequently a thirty-year-old specimen has generally not more than about 10 per cent. of sapwood. The timber, however, has a serious fault in that it seasons badly in the log, deep radial cracks appearing after a few days' exposure to the sun. This fault might be overcome to some extent if the trees were ringbarked, say, twelve months before felling.

This species has been noted growing successfully in the Waikato, Rotorua, Bay of Plenty, and at Paekakariki (near Wellington). It can be recommended for planting in most parts of the North Island, except in the high, cold, inland parts. It has not been very successful in the vicinity of Auckland or in North Auckland in situations exposed to the westerly winds, and in these parts it should be planted only in good moist soil and in sheltered valleys. The hardy qualities of this tree indicate the probability of its successful culture in the warmer parts of the South Island—say, in Nelson, Marlborough, and Canterbury. Although, on account of its bad seasoning-qualities, the Waikato-grown *E. Macarthurii* does not appear to be suitable for pole-production, the undoubted durability of the timber, combined with the fact that the tree is hardy, recommend its planting in climates where other better and less hardy species cannot be grown.

Eucalyptus viminalis (Manna-gum).—This species is found in Tasmania, Victoria, and South Australia, where it usually develops into a wide umbrageous tree which is not generally regarded as suitable for timber-production. Like many other introduced trees, the manna-gum has changed its habit in New Zealand, and here is generally seen as a tall clean-stemmed tree reaching sometimes to a height of 100 ft., with a diameter of 2 ft. to 2 ft. 6 in. The bark is smooth and bluish-white in colour, and gives the tree a distinctly conspicuous and picturesque appearance. It grows well in cold localities, and has been noted in many parts of the Waikato, at Rotorua and Waiotapu, and in the Manawatu, Hawke's Bay, Nelson, and Canterbury districts. In the Waikato, where perhaps it has shown more rapid growth than elsewhere, the timber has been much used for fencing-posts, for which purpose it has proved satisfactorily durable. The logs, however, split very much in seasoning, and for this reason pole timbers are not usually easily obtainable from it. It is probable that slower-grown timber would prove more satisfactory in this respect. The hardy qualities of this species and the moderate durability of its timber point it out as one suitable for cultivation in the warmer parts of the South Island. It is not recommended for planting for pole-production in the North Island, where many other better species can be grown.

CONIFERS.

Thuja plicata (Western American Red-cedar).—This tree is found over about 300,000 square miles on a region extending from the south-east coast of Alaska, through British Columbia, Washington, Oregon, and North California. It is a tree of the coast and coastal

ranges, and is confined to regions of abundant rainfall and humidity, in chiefly wet or constantly moist situations. It grows into a large tree, 100 ft. to 150 ft. high and 3 ft. to 8 ft. diameter; exceptionally 200 ft. high and 16 ft. diameter. The wood is light, reddish-brown in colour, soft and easy to split, and of great durability. It is extensively used for shingles, is the chief pole timber in the United States, and is used for interior and exterior parts of buildings, joinery, patternmaking, tubs, buckets, and tanks.

The red-cedar is not an uncommon tree in New Zealand, and specimens may be found in most public gardens and parks. Cold conditions appear to suit it better than warm ones, and a humid atmosphere better than a dry one, while atmospheric humidity is as important as soil-moisture. Suitable conditions may generally be found throughout the interior of the North Island, at altitudes, say, from 1,000 ft. to higher. In the South Island suitable conditions will probably be found at lower altitudes. Localities in which the soft-fronded ferns are found in the native bush may generally be regarded as favourable for the growth of this tree. It is very tolerant of shade and can be grown interplanted in the native bush, but in such situations its growth is likely to be slow.

Sequoia sempervirens (Redwood).—The habitat of this tree is restricted to a comparatively small territory in the States of Oregon and California, where it is found as a coastal tree never distant more than thirty miles inland, and at elevations from sea-level to 2,500 ft. It is a very large-growing tree, exceptional specimens 350 ft. high, with a diameter from 18 ft. to 20 ft., having been measured. The timber is light, soft, moderately strong, and very durable in contact with the soil. It is extensively used for joinery, general house-construction, interior finish in railroad-cars, tanks, vats, flumes, conduits, shingles, railway-sleepers, posts, and poles. Specimens of redwood have been noted in almost every part of New Zealand. It thrives best, however, where the rainfall is above 30 in. a year and well distributed, and where the atmospheric humidity is high. It should not be planted in exposed sites, as the tops of the trees are easily broken off by strong winds.

Cupressus Lawsoniana (Lawson's Cypress or Port Orford Cedar).—The native home of this tree is a restricted range in south-western Oregon and North California, where it extends from sea-level to an altitude of 5,000 ft. and from ten to forty miles inland. Like all the trees from that part of the world, Lawson's cypress requires a climate characterized by moderate temperatures, heavy precipitation, high humidity, and many cloudy days. Its height is from 125 ft. to 180 ft.; diameter, 3½ ft. to 6 ft. The wood is fine-grained, hard, firm, and easily worked, and is very durable in contact with the soil. It is one of the most valuable of the North American timbers, but, owing to the limited supply, it has there not been used much outside of the restricted region in which it is found. Lawson's cypress has been extensively used for ornamental planting throughout New Zealand, and has adapted itself to a wide variety of soil and climatic conditions. It succeeds best, however, in moist land, provided the drainage is good; atmospheric humidity is also very necessary. It is perhaps not so exacting as *Thuja plicata* in respect to humid conditions, but, in order

that it may reach its best size, situations approximating those recommended for the *Thuja* should be chosen.

Pseudo-tsuga Douglasii (Douglas Fir or Oregon Pine).—This well-known tree came from western North America, where it occurs over a wide range from British Columbia to California. Under the best conditions it reaches a height of 180 ft. and a diameter of 3 ft. to 6 ft.



FIG. 2. SHOWING IN CENTRE OF PHOTO A WESTERN AMERICAN RED-CEDAR (*THUYA PLICATA*), HEIGHT 50 FT., GIRTH 5 FT., AGE 25 YEARS.

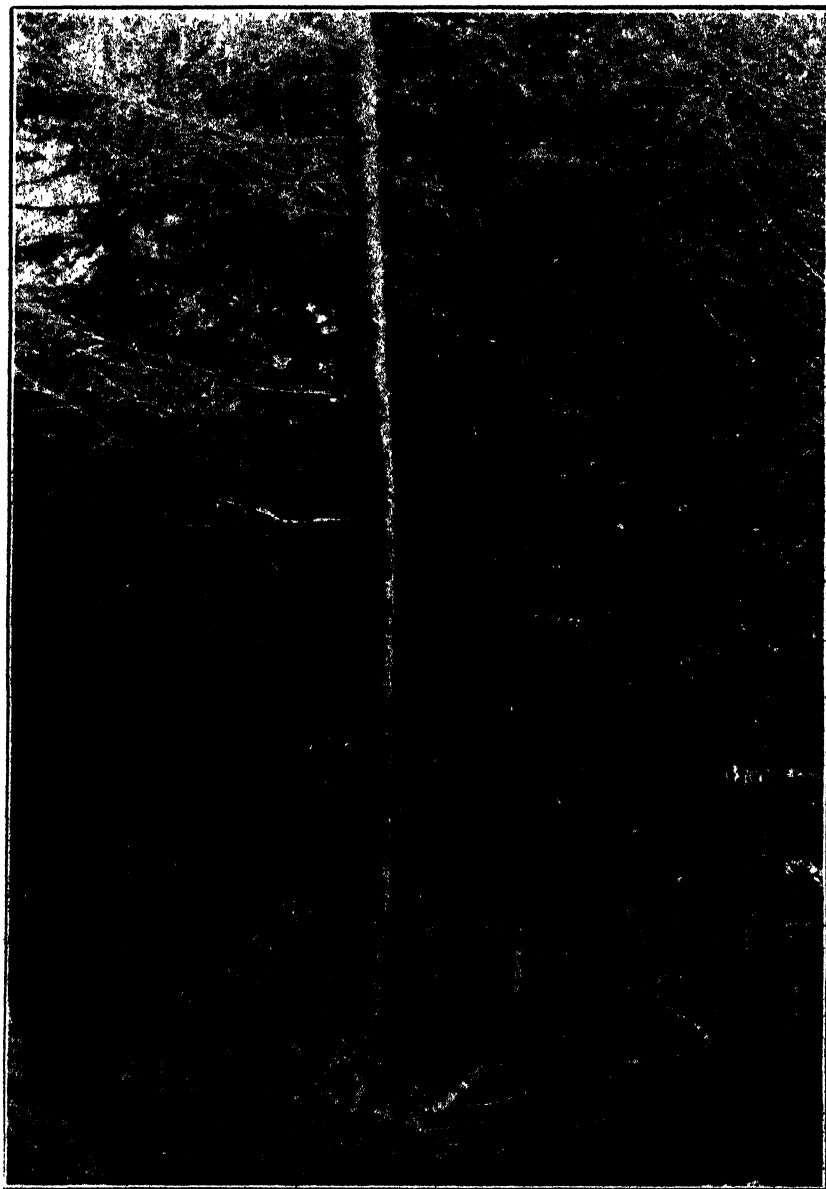


FIG. 3. A 22-YEAR-OLD PLANTATION OF LARCH AND CALIFORNIAN REDWOOD.

The two middle trees in foreground are : To left—European larch, height 48 ft., girth 2 ft. 8 in. ; to right—Californian redwood, height 48 ft., girth 3 ft. 11 in.

The timber has a well-known commercial value for general constructional purposes. It is also used to a large extent by railway and telegraph companies for telephone and telegraph lines and signal wires, and for electric-tram poles, bridge-timbers, and paving-blocks, for all of which purposes it is usually treated with creosote or zinc chloride as a preservative. Grown under proper forest plantation conditions, Douglas fir develops a tall tapering pole, which is of light weight and comparatively strong. It produces durable heartwood early in life, but the sapwood is not durable in contact with the soil unless it receives preservative treatment. The splendid straight poles which it produces, and the probability of the development of timber-preservation in the comparatively near future, indicate a wide use for this timber for transmission-line purposes.

Douglas fir may be seen thriving well in most parts of New Zealand. It does best, however, in a cool climate, in moist, well-drained soil and humid atmosphere. Hot, dry conditions, such as prevail in the clay lands in part of the Auckland Province and in the drier parts of Hawke's Bay, Marlborough, and Canterbury, result in the tree making poor and unhealthy growth. It stands a fair amount of exposure to strong winds, but the saline winds prevalent on the west coast of the Wellington Province periodically injure the foliage.

Larix Europaea (European Larch).—This tree is indigenous to the Alps and the Carpathian and Moravian Mountains of Europe, where it is mostly found at from 3,000 ft. to 6,000 ft. elevation. Under average conditions it reaches a height of 80 ft. to 100 ft., with a diameter of 18 in. to 24 in. The timber, which is moderately heavy and strong, is used in Europe for railway-sleepers, mining purposes, and poles. It is, however, customary to treat the timber with a creosote preservative. Larch can thrive in a much lower mean annual temperature than any other of the trees described in this article, and may therefore be useful for planting in some of the cold uplands of the South Island. Although able to resist very cold weather, it is rather susceptible to late spring frosts, which may injure the early spring growth. It should therefore be planted on the slopes of hills where the drainage is good. Larch has proved a good grower on the hill country at Hanmer Springs and throughout the hills on various parts of Canterbury and Otago. In the North Island it has grown well at Rotorua and Waiotapu, but, generally speaking, has not been a success at elevations lower than 1,000 ft. It may be recommended as a good tree to plant where the climate will not permit the growing of any of the eucalypts.

GENERAL.

While the primary object of the foregoing article is to deal with the growing of trees for pole-production, a sufficient description has been given of the quality and uses of the timbers to show that the species in question produce timbers suitable for a variety of purposes. Several of these species can rightly be specified as among the best of the world's timber-trees, and are worthy of inclusion in any plantation scheme. Provided that a good tree is chosen and planted in an environment which suits it, it will ultimately produce timber which will be sure to find a ready and profitable market.

TESTING OF NEW-ZEALAND-GROWN WHEATS.

II. QUALITY OF FLOURS FROM SOME RECENT SAMPLES.

L. D. FOSTER, Analyst, Chemistry Section, Wellington.

IN the *Journal* for June last the milling-qualities of some forty-four samples of wheats, representing a fairly wide range of varieties, were discussed and the results summarized. The flours obtained from these wheats have now been examined; the quality of the different samples, and their probable behaviour when baked into bread, are indicated in the following matter.

All the flours in question were allowed to mature for not less than four months. Storage of both wheat and flour for a few months increases their capacity for the absorption of water, and results, in the case of flour, in a marked improvement in colour. Where the conditions are favourable, storage for quite lengthy periods of time, extending perhaps to years, has a most decided effect on strength or baking-quality; improvement in volume, texture, and shape of the baked loaf generally results.

The same varieties of wheat differ fairly widely in appearance when grown in different environments, but no obvious mistakes have been noticed in the naming of varieties. The names of the samples are given as received at the Laboratory, and it is thought that they are reasonably reliable in this respect.

The weight per bushel is, for purposes of comparison, again included in the table of results (page 256), but it will be noticed that there is no general correlation between such weights and the quality of the grain.

The question of the colour of these experimental flours has been investigated in this series. It is impossible, of course, in a model mill to clean the wheat as thoroughly as is done with the elaborate processes of modern milling, or to exclude dust from the various operations; the colours given in the accompanying table must therefore be accepted with a certain amount of caution. Each series of flour as it was tested, however, was compared with a good commercial sample of baker's flour. In three cases no description of colour is given; these were the first three wheats to be milled this year, and the mill was still contaminated to a certain degree with dust. The figures giving the percentage of ash show that the greater number of the samples were reasonably free in this respect. Certain samples are described as white when they gave a dead-white colour by the Pekar test; others are described as good, medium, &c., a light-cream colour being considered the best. The colour of the crude gluten is not given in the table, but there was found to be a very close relationship between the colour of the flour and the colour of the gluten.

The water-absorption figure gives an indication as to the amount of bread which may be made from a given weight of flour. The higher this figure, the greater will be the number of loaves made from each sack of flour. It is also a fact that a flour which absorbs more water when being made into a dough generally produces a loaf larger in volume, more palatable, better in appearance, and more nutritious.

The ratio of wet to dry gluten gives a good indication of the probable behaviour of the flour in the bakehouse. Where the ratio of wet to dry gluten ranges from 2.9 to 1 to 3.1 to 1 the quality of the gluten may be considered good, and the dough will give a good expansion in the oven. Where the ratio is greater than 3.1 to 1 the gluten becomes weak and will not stand much fermentation. Where it is less than 2.9 to 1 the gluten becomes tough and needs strong fermentation to develop a satisfactory loaf. An estimation of the quality of the crude gluten as determined by its colour, cohesiveness, adhesiveness, and elasticity is also included. There is in general a close correlation between the quantity of gluten, its quality, and the strength of the flour as determined from the volume of the loaf baked from it. In the table the samples are arranged in varieties and in order of their strength or probable capability to produce large loaves of good texture. For further information on the baking-qualities of New Zealand flours the reader may refer to articles in the *Journal* for July, August, and September, 1923.

NOTES ON THE TABULATED RESULTS.

Considering now the quality of these wheats, it is found that the samples of Velvet again maintain a very good average. The quality of the gluten is in general good, and samples R 1189 and 1200 contain excellent amounts; they are good, strong samples of this variety; R 537 and 1201 may be considered medium strong. With the exception of R 537, these samples do not show the same good capacity for water that has previously been noted, but most samples examined this year have proved lower in this respect than those reported on in 1923.

Of the samples milled as Tuscan, the first, R 745, is a good strong wheat; this sample gave only 67.1 per cent. of flour, which is low, but otherwise it appears to be a good all-round wheat. The remaining samples range from medium to rather poor in quality; in general they appear to give flour of good colour.

Two of the White-straw Tuscan, R 726 and 1193, are good all-round wheats, milling respectively the very good amounts of 74.5 and 75.7 per cent. of flour of good colour and good strength. R 726 is an improved White-straw Tuscan grown from seed obtained from Lincoln College; it contains the large amount of 15.05 per cent. gluten of good quality. The sample grown at Ashburton, R 1193, is nearly as good.

The average of the Solid-straw Tuscan is good, notwithstanding the inclusion of three weathered samples in this series. R 825, though weathered, is a good strong wheat, possessing a very good amount of gluten of fairly good quality. The colour of the flour from these weathered samples, R 824, 825, and 826, was unsatisfactory, though otherwise they are quite fair. R 1205, 535, and 826 may be considered to be medium-strong wheats, R 535 possessing a good capacity for water. The remaining two samples are wheats of medium quality.

Two samples of Victor milled well, R 1209 giving the very high yield of 77.1 per cent. flour. As is usually the case with this variety, however, the amount and quality of its gluten were poor. The colour of the flour was in each case a dead white. The three samples of

Table II.—Tests for Quality of Flours from New-Zealand-grown Wheats (Second Series).

Laboratory No.	Variety.	Locality.	County.	Year harvested.	Calculated Weight per Bushel.	Flour.	Moisture.	Absorption of Water.	Gluten, Wet.	Gluten, Dry.	Ratio of Wet to Dry Gluten.	Protein, % (N x 6.25)	Ash.	Colour of Experimental Flour.	Quality of Gluten, &c.
					lb.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.		
R 1189	Velvet	Ashburton	Ashburton	1924	62	72.9	13.41	51.6	46.40	14.72	3.15 : 1	14.00	0.39	Medium	Fairly good.
1200	"	"	"	1924	64½	73.1	13.46	47.2	46.12	14.04	3.28 : 1	14.44	0.53	Good	Good.
537	"	Pukeuri	Waikati	1923	63	72.5	13.44	54.4	33.72	11.83	2.85 : 1	11.31	0.56	Medium	"
1201	"	Lincoln	Springs	1924	66	71.7	13.72	47.8	36.63	11.50	2.79 : 1	11.03	0.62	"	"
539	"	Fairlie	Mackenzie	1923	63	70.0	13.50	53.2	27.29	9.80	3.18 : 1	9.44	0.37	Good	Rather poor.
746	"	Gibbston	Lake	1923	65½	70.6	13.74	51.6	25.53	8.72	2.93 : 1	8.31	0.63	"	Good.
R 1210	College Hunters	Lincoln	Springs	1924	66	74.4	13.43	45.8	35.08	11.67	3.01 : 1	11.00	0.64	Fair	"
538	"	Rangitata	Geraldine	1923	64	73.4	13.49	49.8	27.35	9.90	2.76 : 1	10.56	0.57	Poor	Rather poor.
R 745	Tuscan	Lake Hayes	Lake	1923	64½	67.1	13.18	49.6	42.23	13.90	3.04 : 1	13.19	0.60	Good	Good.
744	"	Pembroke	"	1923	65	71.9	13.26	49.0	30.14	10.21	2.95 : 1	10.50	0.62	"	"
747	"	Crown Terrace	"	1923	65½	68.0	13.53	50.4	27.71	9.17	3.02 : 1	9.54	0.50	Good	"
542	"	Waitawa	Levels	1923	62	70.5	13.23	50.8	23.27	8.70	2.68 : 1	9.63	0.61	"	Poor.
748	"	Arrowtown	Lake	1923	63½	70.2	13.04	49.6	21.06	7.31	2.88 : 1	8.06	0.53	"	Rather poor.
R 726	White - straw	Seddon	Awatere	1923	64½	74.5	13.49	51.2	44.67	15.05	2.97 : 1	13.75	0.64	"	Good.
Tuscan															
r193	Ditto	Ashburton	Ashburton	1924	65½	75.7	13.28	49.0	43.39	13.75	3.16 : 1	13.06	0.56	"	"
727	"	Seddon	Awatere	1923	62	72.4	13.74	50.4	19.37	6.57	2.95 : 1	7.44	0.55	White	Poor.
R 825	Solid - straw	Cust	Rangiora	1923	63	70.1	13.57	49.8	36.12	12.56	2.88 : 1	12.69	0.58	Poor	Fairly good; weathered sample.
Tuscan															
1208	Ditto	Rakaia	Ashburton	1924	63½	72.4	13.42	49.2	35.85	12.37	2.90 : 1	11.38	0.37	Very good	Good.
535	"	Glenavy	Waimate	1923	61	69.2	12.54	53.8	30.76	11.34	2.71 : 1	10.88	0.64	"	Fairly good.
826	"	Hawkins	Malvern	1923	59	64.6	13.66	49.6	30.76	10.80	2.85 : 1	10.31	0.45	Poor	Good; weathered sample.
824	"	Cust	Rangiora	1923	62½	69.3	13.23	50.6	29.49	10.33	2.84 : 1	10.56	0.60	"	Fairly good.
1203	"	Rakaia	Ashburton	1924	65	72.1	13.68	46.8	29.94	0.81	3.05 : 1	10.91	0.53	Very good	Medium.
R 1209	Victor	Horreville	Eyre	1924	63½	77.1	13.57	47.8	24.60	8.23	3.00 : 1	8.50	0.57	White	Rather poor.
543	"	Tenuka	Geraldine	1923	62½	73.0	13.90	49.0	22.13	8.07	2.74 : 1	8.56	0.56	"	Poor.
R 1205	Yeoman	Irwell	Ellesmere	1924	65½	71.8	13.48	50.4	33.16	10.78	3.08 : 1	10.25	0.56	Good	Good.
S 16	"	Marton	Rangitikei	1924	65	73.0	13.81	51.0	31.04	9.78	3.17 : 1	9.63	0.56	"	"
R 1204	"	Lincoln	Springs	1924	64	72.0	13.76	51.6	24.07	8.14	2.96 : 1	7.94	0.66	White	Medium.

R	536	Dreadnought ..	Weston	..	Waitaki	..	1923	63	72.5	13.15	54.6	34.47	12.15	2.84 : 1	11.00	0.63	..	Good.
	541	"	Studholme	..	Waimate	..	1923	65½	72.9	13.06	50.8	29.58	10.55	2.80 : 1	10.56	0.61	..	Fairly good.
R	1195	Major	Ashburton	..	Ashburton	..	1924	64½	74.1	13.35	48.6	37.75	11.79	3.20 : 1	12.50	0.54	..	Good.
S	17	"	Marton	..	Rangitikei	..	1924	65	74.4	14.09	50.0	26.46	8.59	3.08 : 1	8.56	0.60	..	Poor.
Miscellaneous.																		
R	1198	Essex Conqueror	Ashburton	..	Ashburton	..	1924	62	68.2	13.52	46.8	15.74	13.91	3.30 : 1	15.13	0.49	..	Fairly good.
	1197	Marquis	"	..	"	..	1924	66½	73.7	13.06	50.2	41.79	13.53	3.09 : 1	13.50	0.59	..	Good.
	1196	Red Fife	"	..	"	..	1924	66	71.2	13.30	51.2	38.00	13.51	2.81 : 1	15.06	0.51	..	"
	1196	Red Fife	"	..	"	..	1924	66	71.9	13.35	48.8	36.95	12.87	2.87 : 1	12.50	0.51	..	"
	540	Red Straw	Fairlie	..	Mackenzie	..	1923	63	71.1	12.94	55.0	34.15	12.72	2.68 : 1	12.19	0.62	..	Fairly good.
	1194	Queen Fan	Ashburton	..	Ashburton	..	1924	66½	72.7	13.33	50.8	41.06	12.57	3.28 : 1	12.69	0.50	..	Good
	1199	Zealand	"	..	"	..	1924	67	73.5	13.85	48.8	35.32	12.29	2.87 : 1	13.50	0.52	..	"
	1190	Queen Fair	"	..	"	..	1924	65	76.8	13.08	50.2	37.62	12.14	3.00 : 1	11.75	0.55	..	Good.
	1207	Hybrid W.	Horreville	..	Eyre	..	1924	62	75.6	13.37	49.4	36.41	12.02	3.03 : 1	11.13	0.60	..	Fairly good.
	737	Burbank's Super	Omihl	..	Rangiora	..	1923	64½	70.0	13.40	55.8	35.45	11.95	2.97 : 1	11.63	0.67	..	Good.
	1191	Turretfield	Ashburton	..	Ashburton	..	1924	63	75.3	13.01	47.6	34.51	11.32	3.05 : 1	11.56	0.56	..	"
Eclipse																		
	1206	Snowdrop	"	..	"	..	1924	62½	71.4	13.69	47.6	29.09	9.47	3.07 : 1	9.54	0.52	..	Medium.
	1202	Borcher	Lincoln	..	Springs	..	1924	65	74.0	13.96	48.0	24.37	8.29	2.91 : 1	9.25	0.53	..	Poor.

Yeoman did not appear to be better in quality than the average wheat grown in the Dominion; but samples grown in different seasons and in different environments are required in order to ascertain the suitability of new varieties, such as Yeoman, to local conditions.

Dreadnought again gave good results. The two samples tested were both medium-strong wheats, one possessing a very good capacity for water. Two samples of Major milled well, giving 74.1 and 74.4 per cent. of flour of good colour. The sample from Ashburton may be regarded as a medium-strong wheat.

The miscellaneous samples are remarkable for their average very good strength. Most of these were grown at the Ashburton Experimental Farm, and contain an amount of gluten much above the average. Whether this is due to the varieties themselves or the growing season experienced in the summer of 1923-24, or whether it is owing to the environment in which these wheats were grown, only the testing of further samples from future harvests will show. The following contained very good amounts of gluten of good quality, and are good, strong samples: Essex Conqueror, Marquis, Junbuck, Red Fife, Red Straw, and Queen Fan. Five samples are medium-strong wheats: Zealand, Queen Fair, Hybrid W., Burbank's Super, and Turretfield Eclipse.

The miscellaneous samples of good strength give average amounts of flour. The best, Essex Conqueror, is not generally regarded as a particularly strong wheat, but it is worthy of note that of some nineteen samples received from Ashburton three years

ago Essex Conqueror was again the best in this respect. Marquis, it may be noted, is the famous variety of Canada and the United States. Jumbuck is a Farrer cross. Red Fife is a strong wheat, at one time grown extensively in Canada; it is considered to be of good quality for breadmaking. This variety has been used largely in cross-breeding experiments. Marquis is said to be a cross between an Indian wheat and Red Fife, and Yeoman is another wheat with Red Fife as one of its immediate ancestors. Queen Fan, another Australian cross, is considered in New South Wales to be a good wheat from the point of view of yield and the quality of the flour obtained from it. It may be adapted locally to areas of low average rainfall.

VARIETIES AND LOCALITIES.

In most cases only a few samples were received from each county. Where sufficient data are available from this and previous years' tests comparisons have been made.

From Ashburton County fifteen samples were received. Most of these are varieties not grown there on any extensive scale, but they maintain the remarkably good average of 13 per cent. gluten. None, however, is better in this respect than the two samples of Velvet grown in the same county, which contain the very good percentages of 14.72 and 14.04 of gluten. A sample of White-straw Tuscan, R 1193, from Ashburton, also compares favourably with these miscellaneous varieties.

Of four samples received from Springs County, the best two were College Hunters and Velvet, both good, medium-strong wheats. The strongest wheat from Waitaki County was a sample of Dreadnought, R 536; in 1923 this variety was also the best tested from that district.

Samples from Lake County show a higher average strength than those tested previously. One very good sample of Tuscan, R 745, grown at Lake Hayes, contained 13.90 per cent. gluten. A sample of selected White-straw Tuscan grown at Seddon, Awatere County, contained the large amount of 15.05 per cent. gluten, and is a wheat of excellent quality.

SUMMARY.

There is no correlation among these samples between gluten content and calculated weight per bushel.

The colour of the crude gluten shows in general a very close relationship to the colour of the flour as obtained in the experimental mill.

Velvet retains its position as a wheat of good strength. The quality of the various Tuscan shows considerable improvement, and when a few poorer and extreme samples are disregarded the average is very good. Victor again proves to be a wheat giving very good yields of flour, but of inferior strength. Dreadnought is still a good medium-strong wheat. One sample of Major was a good wheat; the other was poorer in quality.

The miscellaneous samples show a very high average of gluten content. Most of these came from Ashburton County; their general

good quality may have been due to the nature of the growing season of 1923-24.

Even when the good quality of the wheats grown at Ashburton Experimental Farm is not taken into consideration, the average strength of the samples tested during 1924 is higher than that of the varieties tested last year.

Corrections.—In the table on pages 402 and 403 of the *Journal* for June last the calculated weights per bushel contain several obvious typographical errors. Wherever the third figure in that column is a "2," this should read " $\frac{1}{2}$." For instance, in the first sample, R 1200 (Velvet), the weight per bushel should be 64 $\frac{1}{2}$ lb. The variety appearing in the same table among the miscellaneous samples as "Comeback" should have been "Jumbuck," as given in the present article.

PUWERA EXPERIMENTAL AREA.

NOTES ON OPERATIONS, SEASON 1923-24.

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THOSE interested in the earlier work at Puwera should consult the previous issues of the *Journal*, which give details of cultivation and other preliminary treatment of the clay gum-lands referred to in this article. In the December, 1922, issue a sketch-plan of the experimental area was included, and references are made in the present article to the numbered fields in that plan. The work has been pursued with the main objects of (1) securing the most suitable grass-pasture, and (2) growing crops and conserving fodder for the lean periods when the production from the pasture is inadequate.

PASTURES.

The Lower-lying Areas.

Field 3a.—This area of 4 acres was sown to a permanent-pasture mixture in April, 1923. The sowing of 36 $\frac{1}{2}$ lb. of seed included rye-grass, cocksfoot, crested dogtail, paspalum, and clovers. The very wet winter which followed the sowing on this field, which is mostly flat and low-lying, had a bad effect on the take. In spite of this, and the several dry, hot spells last summer (November and December), the pasture is now promising well. It consists mainly of rye-grasses, crested dogtail, and clovers. Young cocksfoot-plants are well distributed. The cocksfoot and crested dogtail are growing strongly, except in the case of the former on a small area above the flat. The pasture was top-dressed on 30th May last with superphosphate at the rate of 3 cwt. per acre.

Field 3b.—This section, 10 acres in extent, is in its fourth year, having been sown to grass in the autumn of 1921. The seed-mixture contained 16 lb. Poverty Bay rye-grass and 4 lb. Italian rye-grass, the rest being made up of 5 lb. of paspalum, Waipu brown-top, and clovers: total, 34 lb. per acre. The pasture has been heavily stocked with dairy cows, store steers, and wethers. The field had been top-dressed with basic slag each year at the rate of 2 $\frac{1}{2}$ cwt. per acre. This

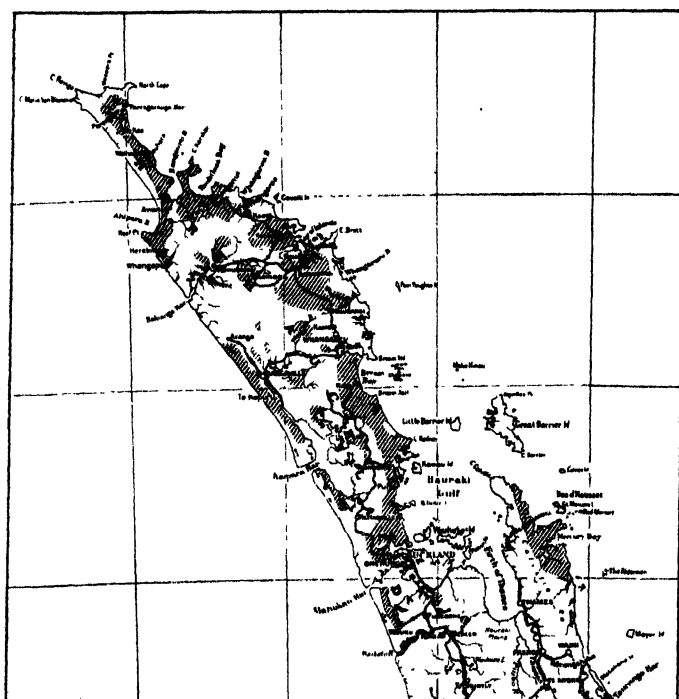


FIG. 1. MAP OF NORTH AUCKLAND, SHOWING THE GUM-LANDS.

The gum-land areas are shaded. Puwera is eight miles from Whangarei.

year 3 cwt. of a mixture made up of equal weights of basic slag and superphosphate was applied on 31st May and 2nd June. Hay and roots have been fed out periodically over the higher portions on the field, where the soil is poorer, and the chain and tripod harrows used regularly to distribute the dung and stir the surface.

The mixture would have been improved by the inclusion of 3 lb. to 4 lb. of crested dogstail, added at the time of sowing down, the pastures on the other fields bearing out this contention. *Paspalum*-plants are well distributed through the sward on the flat and in odd wet places, but very few plants are seen on the higher parts. In spite of this and the omission of crested dogstail, the pasture is remarkably good, and certainly beyond the most sanguine expectations of a few years ago. The rye-grasses and clovers—including red, white, and suckling—predominate, with *Lotus major* well in evidence; brown-top makes up the remainder. With the exception of a little weed-growth—chiefly cudweed, catsear, rib-grass, and field-daisy—found only on odd weak patches, the field is a close strong-growing sward of good grass. Its long period of growth throughout the year is noticeable. The grasses come away rapidly after it is spelled for a couple of weeks, even during the winter.

With the information we now have, this section of Puwera should carry grasses in the mixtures demanding higher fertility than, say, brown-top. The inclusion of cocksfoot and crested dogstail and the leaving-out of paspalum would have combined to produce what is considered farther South to be a better pasture than is found at present. This contention, as regards cocksfoot and crested dogstail, is being put to the test on the adjoining Field 3A. So far the indications are promising. Having regard to North Auckland—mainly its climatic conditions—it may reasonably be claimed that a pasture with paspalum dominant, and a spring growth produced and maintained by top-dressing with phosphatic manures, by chain harrowing, and by careful stocking, would be a better pasture. Certainly in dry summers and autumns it would provide more feed.

The Hill Paddocks.

Field 6.—The section is approximately $10\frac{1}{2}$ acres in area. It is one of the hill paddocks, sloping from the highest ridge on the area down to the main Whangarei-Maungakaramea Road. The soil was first broken up about thirteen years ago, and sown to grass. The grass had run out when the field was rebroken and grassed again in April, 1921. The second sowing of 34 lb. to the acre consisted mainly of Western Wolth's rye-grass, paspalum, and clovers. The pasture has been top-dressed each year. The sward, now in its fourth year, is chiefly paspalum, *Lotus major*, *Lotus hispidus* ("angustissimus"), suckling-clover or trefoil, and a little chicory and yarrow. It has produced satisfactory feed, and has been grazed since July, 1921. The paspalum is getting stronger and more widespread. With the clovers maintained by top-dressing, and the pasture improved by chain-harrowing and judicious stocking, this field is now becoming a paspalum-clover pasture, giving feed of clovers, *Lotus hispidus*, and *Lotus major* in the spring and early summer. From about November paspalum comes away and carries on until the winter. The sward is improving under the treatment outlined.

An area of about 3 acres fenced off on the upper portion of Field 6 was top-dressed on 31st May, 1923, with superphosphate at the rate of 3 cwt. per acre. It was cut for meadow hay in December; the estimated total yield was 5 tons, the hay consisting of paspalum, *Lotus hispidus*, *Lotus major*, and a little Western Wolth and Yorkshire fog.

In parts the grasses of the first sowing are showing up, in some places strongly. Chewings fescue and *Danthonia* are the principal offenders. It is interesting to note that a small percentage of manuka seedlings appeared on the second sowing of grass, but they have now disappeared. No manuka was noticed on the run-out pasture; it is probable that the re-turning of the sod brought buried seed to the surface again.

Field 5.—This area of 12 acres has soil of about the same quality as Field 6; it also lies similarly, but was sown to grass a year earlier. It was set out in eight plots, each $1\frac{1}{2}$ acres in area. The plots run parallel to the main road, which is the lower boundary. From careful observations made periodically on the individual plots sown with different seed-mixtures much useful information has been gained of the behaviour of the various pasture-constituents. Poverty Bay



FIG. 2. A GENERAL VIEW AT PUWERA EXPERIMENTAL AREA.

Looking from Field 4 (unimproved gum-land heath) into Field 5 (pasture plots). On the lower ground in the middle distance are seen various cultivated fields and the nursery, also the Whangarei-Maungakaramea Road. The low hills beyond are typical unimproved gum-lands.

rye-grass has done best of the perennial strains. Cocksfoot, after more than four years' growth, has not done so well, even where the experimental sowings ranged from 13 lb. to 20 lb. per acre. Crested dogstail and *Poa pratensis* are both good. Paspalum has grown well, though it established slowly, except in the wet places, where it showed up in the first season and has since continued to get stronger. Lotus major has associated itself with the paspalum in the wet places, as one would naturally expect. White clover has done well throughout. Waipu brown-top and *Danthonia pilosa* have obviously both found conditions suitable. A useful volunteer among the paspalum is subterranean clover, which has come in apparently from the roadside adjoining, where it is growing in patches. It was not sown on this field, unless the seed happened to have been an impurity in the mixture. Including the dressing of fertilizer with the seed at the time of sowing, this field has received 9 cwt. per acre of phosphatic fertilizer in four years. The annual dressing, therefore, works out at $2\frac{1}{4}$ cwt. per acre. The plot on the ridge was sown with the following mixture: Poverty Bay rye-grass, 16 lb.; *Danthonia pilosa*, 6 lb.; paspalum, 6 lb.; white clover, 3 lb.; alsike, 2 lb.; Serradella, 2 lb.; total, 35 lb. per acre. The sward, now in its fifth year, contains a good deal of rye-grass and danthonia, with paspalum sprinkled through it. White clover is prominent, and, though hardly to be expected because of the quality of the soil, alsike is still seen. Sheep's burnet, sown only on one plot, did well for a couple of years, but has apparently disappeared.

Pioneer Surface-sowings.

Fields 4 and 7.—Field 4 is on the same face as Fields 5 and 6, but the slope is steeper. The surface is more uneven, being broken by a depression down which the surface water flows after heavy rains. Wet patches at intervals, growing rushes and water-grass (*Juncus bufonius*), along this irregular depression indicate surface springs. These springs provide convenient supplies of drinking-water for stock.

Early in February, 1922, an area of $1\frac{1}{4}$ acres near the ridge was tackled, the stunted manuka being cut and subsequently burnt late in March. The area was then disked and cross-disked, which made the rough surfaces more even. In April $\frac{1}{2}$ acre was surface-sown with *Danthonia*, 3 lb.; *paspalum*, 4 lb.; *Chewings fescue*, 1 lb.; crested dogtail, $\frac{1}{2}$ lb.; *Waipu brown-top*, $\frac{1}{2}$ lb.; white clover, 1 lb.; *Lotus major* (colonial), $\frac{1}{2}$ lb.: equivalent to a total of 21 lb. per acre. A fertilizer mixture of equal quantities of super and slag, at 2 cwt. per acre, was broadcast. The remaining $\frac{1}{4}$ acre was sown about a month later with the following mixture: *Paspalum*, 6 lb.; *Danthonia pilosa*, 3 lb.; perennial rye-grass, 3 lb.; *Waipu brown-top*, 2 lb.; *Chewings fescue*, 1 lb.; *Poa pratensis*, 1 lb.; white clover, 1 lb.; *Lotus hispidus*, 2 lb.; *Lotus major*, 1 lb.; yarrow, 2 oz.: equivalent to a total of nearly 27 lb. per acre. 2 cwt. of basic super was broadcast before seeding.

The take, judged in the following spring and summer, was much better on the first sowing than on the second, though the seeding was lighter in the former. When the areas were inspected during the second season the one sown last had improved, but a good deal of *Danthonia semiannularis* had appeared. This grass is found in the adjoining unimproved gum-land, and was on both areas before the surface growth was burnt. Both areas were top-dressed on 29th June, 1923, with a mixture of equal weights of slag and super at the rate of 1 cwt. per acre. Young manuka has come up fairly freely on the surface-sowings, but the mower disposes of this growth. The pasture has been grazed for two seasons, and at present is very satisfactory.

This is a cheap method of getting a sward of grass as an initial step. The cost of the treatment on the first area sown, including clearing, burning, disking, seed, fertilizer, and sowing, works out at about £2 15s. per acre. The seed-mixture could be reduced in cost and a satisfactory covering of grass still be secured. *Paspalum* could be introduced into the sward by feeding out *paspalum* hay, or shifting stock grazing *paspalum* in the summer to the surface-sown pasture.

Kikuyu-grass.

The 1-acre plot in Field 2 laid down during the spring of 1922 in kikuyu, with cow-grass, white clover, and *Lotus major*, has given very striking results. After grazing the area until last spring it was shut up for hay. The cow-grass kept pace in growth with the kikuyu as far as height was concerned. Forced up by the kikuyu, the cow-grass was evenly distributed throughout the sward, and could be easily discerned just before cutting for hay in December, even from the main road, especially by the profusion of seed-heads. *Lotus major* also grew well. Cow-grass, *Lotus major*, and *Lotus hispidus* combine well with kikuyu,

and produce good hay or pasture for grazing. The aftermath was grazed. The winter growth has been better than was anticipated, in spite of cold wet weather, with several frosts in July. Up to the present kikuyu has given more winter feed than paspalum. The close sward of kikuyu excludes weeds. An outstanding feature to which attention may be drawn is that when kikuyu was grown with clovers it produced a large bulk of good forage palatable to all classes of stock, which continued to grow over a long season.

Top-dressing and Chain-harrowing.

The main fertilizer used on the Puwera pastures is basic slag, which gives very satisfactory results. Super mixed with slag or with ground rock phosphate is good, and super used with lime or applied on land previously limed also gives good results. The grass laid down with raw rock phosphate and lime, and top-dressed each year with that mixture, is still poor in comparison with adjacent plots on which rock phosphate alone was applied. Where one light dressing of super was applied across the plots dressed with rock phosphate alone, and rock phosphate and lime, the beneficial results were striking to the eye.

From top-dressing trials on permanent pasture, now in progress, first-year results showed an increase in the yield of hay of 30 per cent. (over no manure) on the plots on which rock phosphate at 3 cwt. per acre was used. From last year's results (second season) the increased yield of hay was a little over 56 per cent., but where a mixture of equal weights of super and rock phosphate was applied at the same acre-rate the increase over no manure was 93 per cent. Compared with the phosphate alone the increase was therefore 37 per cent. These results can be viewed as tentative only.

The subdivision of the area into fields not larger than 12 acres allows of the better handling of stock, so that the pastures are grazed most effectively. When spelled for a week or so the fields are run over with the tripod-chain harrows. The old contention that dung contains "something" which artificials do not may help to account for the progressive improvement of the pastures observed at Puwera. Their carrying-capacity bears this out, and the quality of the pasture may be judged by the rapidity with which stock fatten.

SUPPLEMENTARY FORAGE CROPS.

Mangolds failed in the season under review; it is suspected that the seedlings were eaten by cutworms. John Bull and Superlative swedes and Hardy Green Globe turnips were grown and fed to the cattle along with meadow hay during the winter. Crops of green maize, sorghum, and millet proved useful in the autumn and winter. Sorghum saccharatum was the variety grown, and it produced an excellent crop. Cattle-pumpkins and marrows were grown among the maize, and did well. Oaten sheaf produced in Field 7 was fed to the horses. The sheep received only millet in addition to the grazing on the pastures. Altogether $6\frac{1}{2}$ acres were devoted to crops. Areas of $3\frac{1}{4}$ acres were cut for hay—1 acre of which was kikuyu-grass already referred to.

Incidentally it may be mentioned that pukeko have proved troublesome at Puwera for a number of years. The birds pull up maize, millet, and other seedlings, also red-clover plants.

NURSERY NOTES.

Millet grown with crimson clover produced a useful crop. Crimson clover has consistently done well at Puwera. Durango Upland cotton promised very well; the plants flowered, and the bolls formed and grew well, but bad storms in April and May prevented the crop ripening off. Kudzu grew well, but went off when the winter set in. White-fleshed swedes again gave a good crop, resisting the dry spells and showing no disease.



FIG. 3. A FARMERS' FIELD-DAY DEMONSTRATION AT PUWERA.

LIVE-STOCK.

The pastures and crops grown on the area have carried dry stock continuously and dairy cows for short periods. The carrying-capacity of the improved part of the area works out at the equivalent of a cattle beast to slightly over 2 acres. Store steers, three years and upwards, have become prime in on an average of from ten to fourteen months. Though trouble was experienced with sheep a few years ago, the last lot did well. The pastures are now fit to carry dairy stock profitably.

Noxious Weeds Orders.—Hemlock has been declared a noxious weed in Lower Hutt Borough, and gorse and Bathurst burr in the Russell Town District. Wallace County has declared Californian thistle and ragwort *not* to be noxious weeds.

Sheepowners in the Dominion.—Owners of sheep as at 30th April last totalled 23,423, classified as follows: 100 to 200 sheep, 5,919 owners; 210 to 500, 6,008 owners; 501 to 1,000, 5,071 owners; 1,001 to 2,500, 4,393 owners; 2,501 to 5,000, 1,356 owners; 5,001 to 7,500, 370 owners; 7,501 to 10,000, 152 owners; 10,001 to 20,000, 128 owners; 20,001 and over, 26 owners.

WINTON EXPERIMENTAL AREA.

NOTES ON WORK IN 1923-24 SEASON.

R. MCGILLIVRAY, F.L.S., Fields Division, Invercargill.

THE Winton Experimental Area now comprises a block of nearly 100 acres. The soil, consisting mostly of medium to heavy loam, is on the whole eminently suited for the purpose for which it is used. On the block recently added some drainage operations are required before full use can be made of the land; the remainder of the area is now in a satisfactory condition in this respect. Considerable interest has been shown during the past year in the working of the area, and visitors from as far north as Temuka have called and had the scheme of experiments explained to them. The majority of visitors seemed to be specially interested in the pasture blocks and grazing results; the fodder-crop and wheat areas also came in for much attention. Following is a general summary of the work carried out and the results obtained for the year.

PASTURE INVESTIGATION.

Pure Sowings (Sections 1 and 2, 10 Acres).—This block was laid down in 1920 in pure sowings of the following grasses: Meadow-foxtail, meadow-fescue, timothy, crested dogtail, *Poa pratensis*, *Poa trivialis*, red-top (florin), Yorkshire fog, perennial rye-grass, and cocksfoot (New Zealand and Danish). The object was to ascertain the palatability, duration, and production of the respective grasses under ordinary field conditions. During the past year, in order to ascertain the relative palatability of the various grasses, observations were made as to which varieties were most closely grazed, and regarding the distribution of sheep while grazing on the whole block. Timothy was the grass that stood out above all others in this respect, while *Poa trivialis*, meadow-foxtail, crested dogtail, and perennial rye-grass appeared to be next in preference in the order named. The whole flock were at times to be seen grazing on the timothy, *Poa trivialis*, and meadow-foxtail plots, with the timothy area generally receiving more attention than the other two, and the remainder of the block more or less neglected.

As regards cocksfoot, the area sown with New Zealand seed had a much closer sward than the Danish, although both were sown at the rate of 20 lb. per acre. There actually appeared to be as many plants per square yard in the Danish area, but the amount of leafage was less. This characteristic was most noticeable during the dry weather of last autumn. The New Zealand strain at that time showed a much better growth, with very little bare ground between the plants. There did not appear to be any difference between New Zealand and Danish in so far as palatability was concerned.

The varieties that showed the least growth were red-top and *Poa pratensis*, and Yorkshire fog and meadow-fescue decreased in vitality to a marked extent during the year.

Short-rotation Pasture (Section 3, 5 Acres).—This section is doing well. The seeding was 40 lb. perennial rye-grass, 6 lb. Italian rye-grass, 2 lb.

white clover, and 3 lb. red clover. The pasture has stood heavy stocking well and is still in good heart, and with top-dressing should last in a remunerative condition for a further period of several years. This is a type of pasture much in demand by sheep-farmers at certain seasons of the year. The cost of the mixture is comparatively small, and a profitable return is secured in the first season.

Permanent Pasture (Section 4, 5 Acres).—This block was sown in 1920. There have been many inquiries for the mixture used, so that it will be of interest to again record particulars as follows: Cocksfoot, 14 lb.; perennial rye-grass, 7 lb.; meadow-fescue, 7 lb.; meadow-foxtail, 4 lb.; *Poa trivialis*, 3 lb.; crested dogtail, 3 lb.; timothy, 3 lb.; red clover, 4 lb.; white clover, 2 lb.; *Lotus major*, 1 lb. The most prominent of these grasses at present is crested dogtail, with cocksfoot second, and timothy third in order. The white clover has established well, and is in first-class condition. The pasture is an exceptionally fine one. The carrying-capacity from September until the end of March, 1923-24, was eight sheep per acre, and for the whole year it works out at 5.14 sheep per acre. During some periods the rate of stocking was very heavy. For instance, from 20th to 27th October, both dates inclusive, it carried twenty-four ewes and their lambs per acre, and for three days in December it was stocked at the rate of eighty-nine sheep per acre. Many farmers have been so impressed with the amount of feed yielded and the satisfactory condition of this pasture that they have sown a similar mixture. As indicated, this pasture is now in its fourth year, and competent judges who have been in touch with it since its establishment are of opinion that it is improving each year.

Temporary Pasture (Section 5, 5 Acres).—The mixture used for this pasture consisted of 35 lb. Italian rye-grass and 4 lb. red clover, and was sown on 18th October, 1923. Dry weather was experienced from the start, but the pasture gave considerable feeding until severely attacked by grass-grub last autumn. The section is to be surface-sown with Italian rye-grass to provide plants to take the place of those destroyed by the grub.

Rate of Seeding of Rye-grass (Section 6, 5 Acres).—This is a most interesting block, and has had many visitors. It was laid down with the object of settling the conflict of opinion as to the quantity of perennial rye-grass to include in pasture mixtures in Southland. The field is divided into five 1-acre areas, sown respectively with 10 lb., 20 lb., 30 lb., 40 lb., and 50 lb. of rye-grass per acre. It is quite evident that 10 lb. is too little and 50 lb. far too much. The 20 lb. area is quite good; but, taking everything into consideration, the 30 lb. area is the best of all, and would indicate that from 25 lb. to 30 lb. of perennial rye-grass is about the correct quantity to include in a general mixture in this district.

SUMMER AND WINTER FORAGE CROPS (SECTION 7, 5 ACRES).

These crops consisted of Drumhead cabbage, chou moellier, Buda kale, broad-leaved Essex rape, and Thousand-headed kale. The summer crops experienced dry weather almost throughout their growing-period, and thus yields were not high. Weights taken on 29th February gave yields as follows: Cabbage, 10.88 tons; chou moellier, 17.4 tons;

Buda kale, 19 tons; rape, 14.14 tons; and Thousand-headed kale, 16.86 tons, per acre. The winter crops made rapid growth towards the end of February, and the three varieties kept for the final feeding-test yielded as follows: Cabbage, 27.37 tons; Thousand-headed kale, 25.29 tons; and chou moellier, 27.8 tons, per acre. These three fodders occupied a total area of 1½ acres, and carried 118 four-tooth and six-tooth wethers for twenty-one days, which indicates that they consumed in that time 90,092 lb. of green feed. This works out at 36 lb. per wether per day; or, estimating the average dry-matter content of these forages at 11 per cent., each wether consumed about 3.9 lb. of dry matter per day.

CATCH-CROP (SECTION 8, 5 ACRES).

This section was allotted for swede and turnip tests, but owing to the low rainfall experienced these had to be abandoned. Towards the end of March an area of 3½ acres was worked and sown with 2 bushels Emerald rye-corn, 12 lb. Italian rye-grass, and 4 lb. crimson clover per acre. The resultant growth was good, and much early spring feed has resulted. This is a mixture of high merit, the rye-corn giving a large quantity of feed which is liked by sheep and available at a critical time of the year.

WHEAT TESTS (SECTION 9, 10 ACRES).

The varieties tested were Solid-straw Tuscan, Major, Velvet, and Marquis. All varieties were sown on 3rd October with 2 cwt. basic superphosphate per acre. Marquis was cut on 13th February, and Major and Tuscan on 23rd February. Velvet was very slow in maturing, and was not cut until 5th April. The yields were as follows: Solid-straw Tuscan, 40.33 bushels; Velvet, 24.56 bushels; Marquis, 22.83 bushels; and Major, 18.13 bushels, per acre. One outstanding feature in this crop was the very marked influence of lime on the soil conditions and growth of the wheat. There was an unlimed strip across each plot, and on this area, in the case of each variety, growth was thin and stunted, and the yield would not exceed 5 bushels per acre.

GENERAL.

Ten acres of the newly added land have been swamp-ploughed preparatory to an attempt being made to eradicate creeping-fog grass (*Holcus mollis*), with which this portion of the area is overrun.

Most of the grasses in the pasture blocks, despite very heavy stocking, were inclined to run to seed in January. This was prevented by running the mower over the pastures where necessary.

Mr. W. Campbell still occupies the position of Overseer of the Area, and has carried out much important work during the year.

Importation of Fruit-trees from Australia.—The embargo on the importation of pear, apple, quince, or stone-fruit trees from Australia into New Zealand, which has been in force since 1917, was removed by an Order in Council gazetted on 25th September. The disease *Bacterium tumefaciens* (hairy-root, crown-gall, or root-knot), the occurrence of which gave rise to the embargo, was by the same order deleted from the Fifteenth Schedule of the regulations under the Orchard and Garden Diseases Act.

TESTING OF PUREBRED DAIRY COWS.

JULY TO SEPTEMBER CERTIFICATE-OF-RECORD LIST.

Dairy Division.

THE appended list gives particulars for all cows which have received certificates during July, August, and September, 1924. It will be noticed that a number of good performances are recorded, but space-restrictions preclude special comment on this occasion. The only really outstanding record is that of Mr. A. Christie's Jersey champion, Vivandiere, whose performance was the subject of a special article in last month's *Journal*.

The opportunity is taken of correcting an inadvertency in connection with notes on C.O.R. cows published in the July *Journal*. It was there stated that the dam of Grafton Marigold (bred by Mr. A. A. White, of Manurewa), was Pepper's Girl. This should have been Grafton Crocus, also bred by Mr. White. Grafton Crocus is by Grafton Black Fern (Imp.) from Magnet's Pansy, who goes back to Retford Boy and Waikato's Fancy.

LIST OF RECORDS.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test	Fat req'd for Cert	Yield for Season.			
				Days.	Milk.	Fat.	
JERSEYS.							
<i>Junior Two-year-old.</i>		Yrs.	dys.	lb.	lb.	l.	
Real Lace	A. Christie, Tanekaha ..	1	292	240.5	365	8,831.4	559.51
Roslyn Double's Peace	J. Harris, Bombay ..	1	299	240.5	356	8,593.5	506.20
Rosebank Sunshine ..	B. Hey, Riverlea ..	1	321	240.5	365	7,419.0	498.13
Jersey Lea Daphne ..	S. Bowker, Ihakara ..	1	301	240.5	365	8,635.9	497.66
Ngahiwi Prim ..	W. J. Freeth, Waitara ..	1	293	240.5	346	9,015.6	492.31
Waitangi Baby ..	Truby King, Stratford ..	1	317	240.5	365	7,768.6	481.66
Wairere Sunflower ..	A. Faull, Stratford ..	1	337	240.5	365	8,688.8	475.48
Bridge View Peaceful	A. L. Hooper, Mahoe ..	1	320	240.5	365	8,162.0	472.81
Wairere Gipsy ..	A. Faull, Stratford ..	1	349	240.5	365	8,270.7	407.23
Lady Lonsdale ..	E. M. Spinley, Palmerston N	2	91	249.6	365	8,120.9	466.22
Bridge View Foxglove	A. L. Hooper, Mahoe ..	1	338	240.5	365	7,999.5	455.75
Bridge View Genoa Girl	A. L. Hooper, Mahoe ..	1	314	240.5	365	8,152.8	451.97
Pinewood's Lass ..	J. B. Tonar and Son, Northcote	2	73	247.8	365	7,151.2	449.23
Gowanbrae Malaprop	O. C. Sutton, Richmond ..	1	321	240.5	365	10,572.1	447.88
Atholwood Pink Lady	A. B. Robertson, Hawera ..	1	363	240.5	365	9,088.9	447.49
Lindon Grove Myrtle	M. A. Gadsby, Stratford ..	1	286	240.5	365	7,436.4	429.88
Pelynn Holly ..	L. K. Tarrant, Ngaere ..	1	361	240.5	341	7,292.3	424.15
Parakau Fairy ..	Marshall Bros., Pukeoware..	1	303	240.5	365	8,193.7	420.73
Brentwood Tulip ..	C. A. Willis, Pukekohe ..	1	343	240.5	365	7,562.5	419.33
Pelynn Konini ..	L. K. Tarrant, Ngaere ..	1	357	240.5	344	6,653.7	416.28
Hua Brook Elva ..	A. J. Miller, Uruti ..	1	347	240.5	365	7,336.8	384.03
Bridge View Bluebelle	A. L. Hooper, Mahoe ..	1	363	240.5	318	6,274.2	380.98
Thornycroft Blackbird	S. J. Bennett, Kaupokonui..	2	4	240.9	342	7,363.6	372.42
Briar Bank Princess	R. D. Dagg, Kaponga ..	1	313	240.5	328	6,943.3	370.80
Jenny							
Atholwood Dainty Step	A. B. Robertson, Hawera ..	2	38	244.3	365	7,562.5	364.27
Edgarley's Gracious ..	T. A. Millear, Tuakau ..	1	312	240.5	310	6,297.5	363.51
Elpin Grange O.K. ..	E. S. Walker, Stratford ..	2	4	240.9	299	6,382.9	352.45

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS—continued.						
Junior Two-year-old—continued.		Yrs.	dys.	lb.	lb.	lb.
Bridge View Lady Viola	A. L. Hooper, Mahoe ..	1	176	240·5	365	5,383·8 352·32
Thornycroft Darkie ..	S. J. Bennett, Kaupokonui ..	2	4	240·9	335	6,295·7 341·16
Kahuwera La Perle ..	J. V. Mortensen, Piopio ..	1	322	240·5	365	6,866·9 338·81
Creehton Princess Mai	C. Brock, Eltham ..	2	7	241·2	365	6,992·1 336·61
Elpin Grange Surprise	E. S. Walker, Stratford ..	2	26	243·1	275	5,279·1 331·04
Silverley's Lucy ..	Boon Bros., Poroporo ..	1	290	240·5	329	5,783·5 330·94
Hawkesbury Gold Ladyship	S. J. Goulter, Haumoana ..	1	323	240·5	365	6,848·1 324·34
Meadowvale War Sprite	E. Griffiths, Cambridge ..	2	11	241·6	341	4,888·7 322·04
Viola's Peeress ..	E. Griffiths, Cambridge ..	2	79	248·4	288	5,056·5 319·85
Sunflower's Pansy ..	R. Maddren, Winchester ..	1	261	240·5	365	5,713·3 316·88
Maori Cloudy ..	Aickin and McCarroll, Woodhill	1	321	240·5	332	6,417·8 313·24
Awaroa Queen's Beauty	G. Bright, Otatau ..	1	291	240·5	292	5,200·0 305·80
Rosedale Carnation ..	E. J. Adams, Puni ..	1	319	240·5	353	6,142·4 301·71
Springfield Nancy ..	A. G. Somerville, Takapau ..	1	260	240·5	365	5,630·4 297·89
Heatherlea Lady Swan	H. J. Lancaster, Levin ..	2	33	243·8	322	5,499·8 294·19
Imperial Golden Lass	W. Muir, Waihi ..	2	35	244·0	308	4,924·8 293·06
Taumata Park Lady Melinda	W. D. Knowles, Whenuakura	1	352	240·5	291	5,178·6 292·08
Fidele of Rosy Creek	E. Griffiths, Cambridge ..	1	327	240·5	325	5,009·2 285·51
Grandeur ..	J. Muir, Brixton ..	1	244	240·5	248	5,891·4 283·16
Perfect Life ..	E. Griffiths, Cambridge ..	2	20	242·5	299	4,586·5 277·44
Springbank Dot's Bairn	E. S. Holdaway, Ballance ..	2	52	245·7	287	4,811·7 259·68
Hawkesbury Princess Rosa	J. W. Topham, Temuka ..	2	3	240·8	250	5,303·9 245·65
Pencarrow's Triangle Girl	W. E. Garry, Kumeu ..	1	343	240·5	265	4,675·7 245·29
Senior Two-year-old.						
Rosedale Fairy ..	E. J. Adams, Puni ..	2	299	270·4	365	12,259·7 610·79
Raithwaite Belle*	F. J. Finer, Ngutuwera ..	2	363	276·8	358	11,930·3 600·13
Waionui Princess ..	P. Doyle, Te Awamutu ..	2	280	268·5	365	8,674·9 548·49
Elmsted Girlie ..	R. C. Powell, Bunnythorpe ..	2	296	270·1	342	8,187·7 515·45
Koro Koro Princess ..	R. W. Southee, Kiwitea ..	2	223	262·8	365	9,384·1 503·09
M. C's Charity ..	P. C. Short, Lowgarth ..	2	235	264·0	362	9,550·0 494·65
Linwood Victoria ..	W. V. Hosking, Wharehuia	2	360	276·5	350	8,828·5 492·67
Flower of the Glens ..	L. A. Lancaster (deceased), Kairanga	2	318	272·3	315	7,373·0 485·04
Meadowvale Petrova	S. J. Robinson, Hinuera ..	2	339	274·4	365	7,689·4 476·22
Ianthia ..	F. J. B. Ryburn, Paterangi ..	2	255	266·0	365	7,456·2 439·70
Llangollen Primrose ..	J. T. Entwisle, Cambridge ..	2	341	274·6	365	7,400·7 438·57
Bridge View Duchess	A. L. Hooper, Mahoe ..	2	316	272·1	335	6,940·9 434·86
Featherston Lady ..	J. Davies, Maxwelltown ..	2	337	274·2	353	7,654·0 430·25
Dame Fox ..	J. Swindlehurst, Shannon ..	2	306	271·1	323	7,106·9 422·73
Reid Park Likeness ..	H. N. Svendsen, Pukekohe	2	338	274·3	365	8,279·9 419·75
Roslyn Twin Fairy ..	J. Harris, Bombay ..	2	329	273·4	349	6,350·0 401·93
Violet Swan ..	Dr. F. J. Watson, Bull's ..	2	356	276·1	300	5,978·0 395·93
Hill View Rene ..	R. Wattam, Fencourt ..	2	183	258·8	365	7,199·8 385·66
Middlewood Maggie ..	J. H. Mungavin, Ohau ..	2	251	265·6	315	6,564·2 383·82
Hawkesbury Ladyship Pansy	S. J. Goulter, Haumoana ..	2	331	273·6	365	7,336·4 372·62
Nirvana's Fox ..	G. Bright, Otatau ..	2	227	263·2	345	6,993·3 370·84
Hawkesbury Caroline	W. E. Pilcher, Raumati ..	2	319	272·4	365	7,252·1 345·39
Erindale Lady Winsome	T. H. Broomfield, Kaponga	2	334	273·9	365	5,568·2 339·03

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS—continued.

<i>Three-year-old.</i>						
Zenda* ..	F. J. Finer, Waverley ..	3 327	309·7	335	10,725·6	614·51
Jersey Lea's Faith's Patch	S. Bowker, Ihakara ..	3 323	309·3	365	11,608·4	586·65
Kahuwera's Fairy ..	J. V. Mortensen, Piopio ..	3 362	313·2	365	9,783·6	584·85
Engdale's Match ..	P. Doyle, Te Awamutu ..	3 195	296·5	365	11,682·8	580·06
Qui Vive ..	L. and J. Griffith, Weraroa ..	3 336	310·6	350	10,101·0	573·69
Oakvale Tit Bit ..	J. H. Street, Bell Block ..	3 4	277·4	365	10,020·5	540·03
Edendale Topsy ..	C. A. Care, Reynolds Settlement	3 317	308·7	359	11,246·0	528·72
Fernaig Enid ..	H. W. Le Bailly, Buckland ..	3 219	298·9	365	8,284·0	513·56
Lynford's Nester ..	P. Jones, Woodville ..	3 338	310·8	365	9,435·9	508·56
Maiden's Rosebud ..	J. Klenner, Kaimata ..	3 313	308·3	365	8,895·5	508·03
Volee's Forest Lass ..	P. A. Anderson, Levin ..	3 327	309·7	361	9,232·1	505·78
Silverley's Lady ..	J. S. Jones, Bell Block ..	3 5	277·5	368	8,128·7	492·32
Peggy's Lady ..	J. H. Street, Bell Block ..	3 335	310·5	365	8,770·5	488·68
Jersey Park Bountiful	Boon Bros, Poroporo ..	3 24	279·4	321	7,893·0	483·18
Te Ngutu's Princess ..	H. R. Penny, Okaiawa ..	3 363	313·3	365	9,542·0	476·13
Espanita ..	G. E. Cowling, Manaia ..	3 324	309·4	365	8,475·1	455·32
Anticipation ..	E. Bennett, Cardiff ..	3 363	313·3	299	7,185·7	443·42
Carranza's Daisy ..	J. Klenner, Kaimata ..	3 331	310·1	319	7,840·1	418·74
Magnum Bonum†	R. Clark, jun, Te Kowhai ..	3 41	281·1	325	5,508·5	390·68
Meadowvale Star Queen	W. D. Knowles, Whenuakura ..	3 342	311·2	268	6,938·3	372·36
Riverlea's Vixen ..	Mrs. C. O'Callaghan, Tikinui ..	3 296	306·6	321	5,735·6	360·12
Goldie Locks ..	Mrs. A. Henderson, Hairini ..	3 348	311·8	340	6,023·1	355·91
Jersey Park's Baby ..	W. D. Knowles, Whenuakura ..	3 316	308·6	305	5,801·2	321·54
Jersey Meadows Bess ..	W. E. Pulcher, Raumati ..	3 45	281·5	240	5,418·0	303·01
Springbank Star ..	E. S. Holdaway, Ballance ..	3 31	280·1	251	5,867·0	294·72
<i>Four-year-old.</i>						
Jersey Lea Madge ..	S. Bowker, Ihakara ..	4 359	349·4	365	12,993·9	663·34
Countessa ..	A. J. Luxton, Omata ..	4 278	341·3	365	10,168·1	591·28
Crown Jewel ..	G. E. Cowling, Manaia ..	4 310	344·5	365	9,237·6	574·47
Crofton's Fairy ..	A. J. Luxton, Omata ..	4 331	348·6	365	10,457·2	550·93
Lyndon Flower Girl ..	S. J. Robinson, Hinuera ..	4 357	349·2	319	8,404·6	525·58
Miss Miro ..	J. E. Young, Otakeho ..	4 290	342·5	331	9,259·5	517·71
Alicante ..	J. A. Pettigrew, Phama ..	4 343	347·8	305	9,762·0	507·06
Hawkesbury Gem ..	J. Robb, Westmere ..	4 248	338·3	333	9,751·0	470·75
Pencarrow's Chief Lady	Tokomaru Flaxmill Co., Tokomaru	4 329	346·4	315	7,965·4	465·32
Silver Primrose ..	Mrs. A. Henderson, Hairini ..	4 2	313·7	344	6,098·6	404·32
Yum Yum ..	J. Klenner, Kaimata ..	4 189	332·4	292	7,883·4	403·81
Falconite's Marigold ..	J. Karl, Paterangi ..	4 364	349·9	365	8,071·8	394·73
Meadowvale Gold Girl	W. D. Knowles, Whenuakura ..	4 1	313·6	259	6,536·8	337·83
<i>Mature.</i>						
Vivandiere ..	A. Christie, Tanekaha ..	6 10	350·0	365	17,284·1	1036·09
Maori Nikau ..	R. Clark, jun., Te Kowhai ..	6 228	350·0	365	14,741·9	790·21
Veritas ..	J. H. Street, Bell Block ..	5 295	350·0	365	11,571·2	687·56
Zenith's Maid ..	H. C. Sampson, Hillsborough ..	6 11	350·0	347	10,870·0	634·85
Camboage's Wonder ..	J. Richards, Ohangai ..	6 183	350·0	365	10,100·6	620·47
Oakden Beauty ..	S. R. Lancaster, Palmerston North	7 340	350·0	365	10,928·7	603·02
Cream K. C. ..	A. L. Hooper, Mahoe ..	6 5	350·0	365	10,662·4	598·70
Fury's Solid Gold ..	G. E. Cowling, Manaia ..	5 82	350·0	365	9,850·1	580·72
Toot Sweet ..	C. Jones, Woodville ..	5 335	350·0	365	10,742·1	570·53

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat reg'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS—continued.

		Yrs. dys	lb		lb.	lb.
<i>Mature</i> —continued.						
Treasure's Dot ..	J. Hale, New Plymouth ..	7 286	350·0	365	9,385·8	565·05
Merripit ..	J. V. Mortensen, Piopio ..	6 302	350·0	353	10,892·1	557·86
Jersey Corner Alsike ..	H. J. Lancaster, Levin ..	8 6	350·0	323	10,132·1	551·67
Oakden's Gem ..	J. Robb, Westmere ..	5 267	350·0	365	9,530·2	544·83
Maiden of Jersey Meadows	H. H. Phillips, Te Rehunga	5 328	350·0	361	8,665·0	543·16
Jersey Brae's Necklace	J. T. Entwisle, Cambridge ..	5 325	350·0	365	9,449·3	538·63
Gipsy Gold ..	J. H. Mungavin, Ohau ..	5 325	350·0	337	10,469·0	537·27
Quibble ..	J. J. Scheuber, Hawera ..	5 321	350·0	320	12,356·4	530·19
Maori Pearl ..	H. B. Lepper, Lepperton ..	6 63	350·0	354	9,591·9	535·89
Juanita's Girl ..	R. Maddren, Winchester ..	5 355	350·0	365	9,752·2	518·77
Paratawhiti Gossamer	G. E. Cowling, Manaia ..	7 345	350·0	365	9,333·6	517·34
Jersey Lea Bess ..	S. Bowker, Ihakara ..	5 4	350·0	350	9,441·4	507·77
Clematis of Pelynn ..	L. K. Tarrant, Ngaere ..	5 358	350·0	346	8,894·1	499·94
Optician's Prim's Rose	W. E. Pilcher, Raumatangi ..	7 305	350·0	355	9,373·9	493·46
Glendyfrdwy Cutey ..	S. J. Robinson, Hinuera ..	7 312	350·0	332	8,501·5	489·94
Co-operation ..	J. Muir, Brixton ..	6 45	350·0	242	9,118·4	489·01
Merrivale's Lass ..	S. R. Lancaster, Palmerston North	7 24	350·0	365	11,014·2	480·81
Reid Park's Queenlike	W. C. S. Hosking, Waiuku ..	5 266	350·0	299	10,354·4	477·84
Rose of Rostrevor ..	J. Hunt, Richmond ..	7 349	350·0	365	8,935·2	476·88
Opal Star ..	Dr. H. O. Washbourn, Richmond	6 290	350·0	365	8,619·5	472·07
Peggy's Queen ..	J. Muir, Brixton ..	8 362	350·0	249	9,136·9	471·86
Cavell ..	J. Klenner, Kaimata ..	7 296	350·0	365	8,843·7	468·59
Winnie's Viola ..	D. L. A. Astbury, Mangatoki ..	5 77	350·0	365	6,998·0	455·10
Oakden Rosette ..	C. A. Care, Reynolds Settlement	5 362	350·0	340	8,691·0	453·24
Teresa of Willowbank	J. S. Jones, Bell Block ..	7 6	350·0	294	8,783·8	451·11
Calabria ..	C. Stevens, Maungatapere ..	6 32	350·0	365	8,262·5	450·32
Te Arei's Riotress ..	C. Brock, Eltham ..	10 49	350·0	365	8,919·3	449·03
Beachland's Pansy ..	O. Ross, Waihi ..	8 34	350·0	332	8,790·7	448·73
Lassie's Cherub ..	J. Klenner, Kaimata ..	5 358	350·0	282	9,049·1	435·17
Fox's Freda ..	E. Griffiths, Cambridge ..	6 346	350·0	300	6,851·1	430·44
Waipiko Miriam ..	E. J. Adams, Puni ..	8 301	350·0	320	8,064·4	424·61
Maori Damsel ..	A. A. White, Auckland ..	8 58	350·0	295	7,692·5	423·54
Disdain's Maid ..	H. J. Addenbrooke, Ngaere ..	10 12	350·0	294	7,432·2	417·11
Cidaline ..	E. Griffiths, Cambridge ..	5 234	350·0	336	7,501·1	391·03
Circe of Bull's ..	F. J. Watson, Bull's ..	5 88	350·0	365	8,592·2	386·64
Piakau Ladybird ..	R. E. Clements, Awakino Point	5 14	350·0	298	6,750·7	365·99
Prospero's Fairy ..	H. J. Addenbrooke, Ngaere ..	8 17	350·0	292	6,487·7	359·81
Saxon Girl ..	A. R. Clark, Hamilton ..	8 241	350·0	284	7,633·2	357·82
Zazel ..	J. Swindlehurst, Shannon ..	6 355	350·0	280	7,010·4	350·11

FRIESIANS.

<i>Junior Two-year-old.</i>						
Rosevale Queen Sylvia Triumph*	H. North and Sons, Omimi	2 129	253·4	365	15,240·0	621·23
Ellerlea Colantha Posch*	A. C. M. Finlayson, Kamo ..	1 362	240·5	365	12,330·6	406·51
Tamaki Princess Lily*	R. Marr, East Tamaki ..	2 27	243·2	247	10,242·7	389·81
Pearl Artist† ..	W. Barton, Featherston ..	2 109	251·4	365	10,441·3	362·83

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
FRIESIANS—continued.						
Senior Two-year-old.		Yrs. dys	lb.		lb.	lb.
Mountain Vale Segis Alcartra*	C. Goble, Piakau ..	2 308	271·3	365	20,176·2	676·98
Pareora Dominion Van Thumper*	A. S. Elworthy, Timaru ..	2 206	261·1	365	13,404·1	509·53
Longview Wild Rose Segis*	C. R. Duncan, Whangamarino	2 277	268·5	365	17,022·8	509·40
Mutual Nancy Keyest†	W. Barton, Featherston ..	2 297	270·2	365	11,073·1	361·15
Junior Three-year-old.						
Cloverlea Monona Warden*	E. F. Peacocke, Hamilton ..	3 148	291·8	365	12,839·1	424·99
Senior Three-year-old.						
Woodlyn Rose De Kol*	T. C. Barbour, East Tamaki	3 271	304·1	365	18,110·2	634·07
Woodlyn Colantha Mavis†	T. C. Barbour, East Tamaki	3 310	308·0	342	13,389·2	510·78
Weston Lea Snowdrop Challenge*	E. F. Peacocke, Hamilton ..	3 328	309·8	365	14,399·8	450·56
Monavale Queen Pauline†	R. Marr, East Tamaki ..	3 355	312·5	231	10,252·5	390·78
Junior Four-year-old.						
Woodlyn Stella Manor*	T. C. Barbour, East Tamaki	4 147	328·2	365	19,351·5	683·03
Senior Four-year-old.						
Westmere Pietje Fobes*	R. A. Cameron, Paraparaumu	4 251	338·6	365	20,447·6	650·12
Mature.						
Longbeach Everlasting*	J. H. Grigg, Longbeach ..	5 223	350·0	356	21,631·4	759·93
Longbeach Transvaal Queen*	J. H. Grigg, Longbeach ..	7 221	350·0	352	21,488·2	706·02
Glen Iris Heather Lady*	R. R. Pearson, Rongotea ..	5 2	350·0	365	20,337·9	683·44
Glen Iris Duchess De Kol*	R. R. Pearson, Rongotea ..	6 312	350·0	364	19,301·7	638·33
Princess Manor De Kol*	T. C. Barbour, East Tamaki	6 202	350·0	365	16,632·4	602·85
Dominion Blanche Frisby	C. D. Farm, Weraroa ..	7 139	350·0	355	17,333·2	600·29
Alcartra Segis Van Racelands*	C. Goble, Piakau ..	5 355	350·0	365	15,571·9	554·35
Kokatau Queen* ..	W. H. Madill, Auckland ..	8 154	350·0	365	12,387·6	429·12
Cluny Pietje Vernon†	A. H. Russell, Hastings ..	7 4	350·0	320	11,753·2	403·84
Lady Taureaut† ..	F. Crump, Springston ..	5 318	350·0	341	10,755·6	392·34
Alcartra Jewelt† ..	A. H. Russell, Hastings ..	9 254	350·0	355	10,805·0	375·40

MILKING SHORTHORNS.

<i>Senior Two-year-old.</i>						
Vale Royal Sweet Pea	W. Bowis, Doyleston ..	2 348	275·3	325	7,968·75	308·77

AYRSHIRES.

<i>Two-year-old.</i>						
Rutland Stately II ..	R. Marshall, Runciman ..	2 268	267·3	365	7,252·2	292·76
<i>Mature.</i>						
Queen Mary* ..	E. J. Irving, Ryal Bush ..	5 347	350·0	365	14,760·0	573·65
Turvy I of Ayrshire Downs	Litchfield Bros., Tirau ..	6 364	350·0	348	10,084·7	461·19

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season		
				Days	Milk	Fat.

AYRSHIRES—*continued.*

<i>Mature—continued.</i>			Yrs. dys	lb.		lb.	lb.
Victoria II of Edendale	W. Hall, Lepperton	..	5 317	350·0	337	11,344·4	446·33
Kilmarnock Doris	R. Mars' all, Runciman	..	8 0	350·0	330	9,485·6	372·38

RED POLLS

Dominion Lady Nico-tine	Central Development Farm, Weraroa	2 241	264·6	295	6,147·4	275·11
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Second-class Certificates.

JERSEYS.

<i>Junior Two-year-old.</i>			Yrs. dys	lb.		lb.	lb.
Illawarra Bloom	W. H. Rutledge, Midhurst	..	2 33	243·8	365	7,352·0	414·59
Mountain Lily	G. Buchanan, Paeroa	..	1 250	240·5	365	6,700·5	323·44
<i>Four-year-old</i>			Yrs. dys	lb.		lb.	lb.
Silverstream Lady Fox	G. B. Hull, Silverstream	..	4 292	342·7	365	10,841·7	492·25

REDUCTION IN FEES FOR C.O.R. TESTING.

THE attention of breeders of purebred dairy cattle is drawn to the fact that the Minister of Agriculture has sanctioned a reduction in the fee for testing cows under the certificate-of-record system.

It is to be recognized that the actual testing fee is only a portion of the cost entailed in having a cow's yield authenticated. The necessary supplementary feed required in order that a cow may do herself justice is in itself a considerable item, and there are, of course, other incidental charges embodied in the various smaller special attentions which the cow under C.O.R. test usually receives. The Department wishes to encourage the smaller breeders more particularly. The new charge is to come into effect as from the commencement of the next financial year—namely, 1st April, 1925. For all cows calving for commencement of test after that date the fee for the first cow tested each year on any one farm will be £8 8s., instead of £10 10s., as at present. The fee for subsequent entries will remain at the present amount of £3 3s.

Experience has proved the necessity for differentiating between the first and subsequent entries. This encourages a preponderance of breeders to test more cows than otherwise they would feel disposed to enter. Our desire is to see a larger number of cows with authenticated yields, and it is hoped that this reduction in the fees will encourage even more breeders to have the yields of their purebred stock authenticated.

—W. M. Singleton, Director of the Dairy Division.

Use of Sheep-dips.—In his last annual report the Department's Chemist states that his examination of powder dips has shown that instructions should be given that the dip be made up for twenty-four to forty-eight hours before using, so as to enable its active compounds to get fully into solution. The non-fulfilment of these necessary conditions may result in the dipping proving ineffective.

SEASONAL NOTES.

THE FARM.

PASTURES.

GRASS is now plentiful generally, and every endeavour should be made to keep it in a succulent condition by means of careful grazing so that the best results may be obtained and prolonged. If there is danger of the grass bolting to seed towards the end of the coming month it should, if possible, be controlled by stock. If these are not sufficient the surplus should be cut with the mower and made into ensilage or hay, or even carted off for manure rather than that a good pasture be spoilt. Later patchy roughage can be usefully disposed of by mowing with the machine set high, the material being left to wilt.

Where hay is required with a greater proportion of clovers, and in damper positions not likely to suffer from early dry spells, fields can now be closed. Provided conditions are favourable, if early mowing is practised the hay will not only be better in quality, but the fresh growth of the aftermath will be very helpful at a time when the other pastures may have become rather stale. Hay is the best foundation for winter rations, and on the great majority of farms the supply falls short of requirements. Preparations should be made for the haymaking season by selecting stack-sites on dry, convenient spots, laying down stack-bottoms of old posts, hedge-trimmings, &c., collecting fencing-materials, and overhauling mowers and rakes.

This is seasonable time for sowing temporary pastures. A mixture of 30 lb. rye-grass and 5 lb. red clover will give a large amount of feed. As a rule, spring-sown pastures have a higher clover content than those autumn-sown.

GREEN FORAGE CROPS.

The main sowing of rape will usually be made early in November. Details regarding this crop and the kales were given in last month's notes.

Maize: In average districts the middle or end of November will be quite early enough for sowing maize for forage purposes. Earlier sowing is risky, as the young plants are very apt to become checked when a few inches high. A cold, wet spell at that time seriously affects the crop and allows the weeds to get ahead of it. A common mistake is to sow too shallow; the best results are obtained by placing the seed at least 2 in. deep. Phosphatic manures should be used, together with some nitrogen, on the less fertile classes of soil; a mixture of 2 cwt. super with $1\frac{1}{2}$ cwt. blood-and-bone is suitable. Maize is not among the best of feeds for milk-production when grown alone; it is better combined with either Partridge peas or Scotch tares, $1\frac{1}{2}$ bushels of each per acre. Hickory King, Ninety Day, and Red Hogan are good fodder varieties.

Japanese millet: In many districts, especially in the North Island, this crop is a very useful one for grazing dairy cows during dry weather. Also, in localities where rape or kale cannot be successfully grown for lamb-fattening, millet may be tried, as it gives fairly good results. It should be sown from mid-November to mid-December, and requires a warm soil and fairly fine tilth. Farmers should beware of sowing too large an area at any one time, as the crop grows rapidly and soon becomes too rank for economical grazing. It should be sown so as to feed off in breaks. Sowing is at the rate of 16 lb. to 18 lb. through every second coulter of the drill. Superphosphate, 2 cwt. to 3 cwt. per acre, is a suitable fertilizer. Millet being somewhat exhausting to the soil, it is a good plan to sow 5 lb. or 6 lb. of red clover with it, to provide grazing in the late autumn and a cut of hay in the following year, after which the roots and stubble may be turned in to enrich the soil before the next crop is sown. An alternative plan would be to plough in the clover in September for a spring-sown crop. Rape is also sometimes sown with millet at the rate of about $1\frac{1}{2}$ lb. per acre; in such case the seeding of millet should be reduced to 12 lb.

ROOT CROPS.

Swedes: In Otago and Southland especially the sowing of swedes should be put in hand during the coming month. No real substitute has so far been found for the swede in those districts, and farmers should therefore, by means of good cultivation and generous treatment, endeavour to produce high yields of this valuable winter fodder. Often large areas are sown, but for want of care only very moderate crops result. The aim should be to produce a heavy crop on a restricted area rather than a poor crop scattered over a large acreage. In most cases a more generous application of fertilizers than hitherto customary will pay handsomely. Swedes succeed best as a first crop out of grass, and are more free from disease such as club-root if the land has been previously well limed. If sown in ridges, and the ground is abnormally dry, the ridges should be rolled immediately after sowing. This assists the moisture to come to the surface, hence germination is more uniform. Be careful not to bury the seed too deeply. Seeding, if on the flat, is at the rate of 8 oz. to 10 oz. per acre, through every second or third coulter; or $1\frac{1}{2}$ lb. to 2 lb. if in ridges 28 in. apart. In many districts, apart from those mentioned, swede-sowing may conveniently be left till December. The warning given in last month's notes as to the avoidance of the grass-grub beetle ("turnip-fly") should be kept in mind in connection with root and rape crop sowings.

Carrots: From the ¹/₂ middle to the end of November is a good time to sow the Guerande carrot for sheep-feeding. This variety is gaining in popularity for that purpose. It is best sown on ridges 21 in. to 26 in. apart; this permits intercultivation with a horse-hoe to control weeds and retain moisture. If the land is reasonably clean and no ridger available, sowing may be done on the flat through every coulter of the drill. Sow from 1 lb. to $1\frac{1}{2}$ lb. seed per acre. When sown on ridges it will pay to run over them once

and pull the weeds. Thinning is not necessary with this variety. Any good phosphatic fertilizers or proprietary manures, at the rate of about 3 cwt. per acre, are suitable.

Mangolds: The main sowing of mangolds will be generally made early in November. It has been demonstrated time and again that a smaller area carefully and well worked pays very much better, and in every way gives more satisfaction, than double the area only indifferently treated. Instances can be given where, with proper cultivation and reasonable manuring, crops of from 75 tons to 110 tons per acre were produced last season at a cost of from 3s. 6d. to 3s. 11d. per ton, including interest on capital value of land, manures, &c., and allowing good wages for every operation connected with the crop. Mangolds are one of the crops that can be successfully repeated on the same ground, provided weeds are controlled and adequate manuring given. The second crop often proves better than the first, principally as a result of the extra cultivation of the previous year. Details as to the sowing, &c., of mangolds, [also soft turnips, were given last month.

LUCERNE-ESTABLISHMENT.

Fields that are being prepared for lucerne should be frequently worked during the coming month, so as to destroy weeds and get the land into good condition for sowing. If the land is not clean it is better to delay sowing for a while. The third week of November is usually early enough, and in many districts the best results are secured from December sowings. Lucerne requires a firm seed-bed, consequently the land should be well consolidated with the Cambridge roller. Where no roller can be procured fair consolidation may be obtained by driving sheep backwards and forwards over the ground. The land should have been previously limed with at least 10 cwt. carbonate of lime or 5 cwt. burnt lime per acre, but double these quantities would be an advantage.

The seed should be sown at 15 lb. to 20 lb. per acre, and is best drilled in through every coulter of the drill, or half may be drilled one way and half cross-drilled, taking care to drill as lightly as possible so that the seed will just be covered, and finishing with the roller. Next to drilling, broadcasting after the roller is recommended; with this method not less than 20 lb. of seed per acre should be sown. If the land has been limed, 2 cwt. superphosphate per acre may be applied with advantage; if no liming has been done, basic super or basic slag, 3 cwt. per acre, is best used. It is good practice to mix the seed and manure and sow at once. The seed should never be mixed with superphosphate and allowed to stand for, say, a few days before sowing, as this retards germination.

In some localities lucerne will do well without inoculation, while in others it is absolutely necessary to inoculate in order to establish a stand. As a rule it pays to inoculate; even in localities where lucerne can be grown without inoculation it is found that the stands establish quicker when it is practised. There are various ways of introducing the bacteria, but for ordinary farm practice 2 cwt. to 3 cwt. of soil from a vigorous well-established lucerne-stand, broadcast and harrowed in just before drilling, can be recommended.

The second year is frequently a crucial time with lucerne. Stands that go ahead well in the first year often go off badly in the second season, showing yellow sickly patches and making poor growth. In such cases the farmer must have patience, as the majority of such stands overcome their trouble in the autumn, and, with proper management, do well afterwards. —*Fields Division.*

THE ORCHARD.

THINNING AND SUMMER PRUNING.

At this season of the year all varieties of stone-fruit will have set, and the pip-fruits will soon be reaching that stage. Wood-growth will also be fairly free if trees are in a healthy thriving condition. Both these factors will call for a certain amount of extra work during the next two months by way of thinning the fruit and also a reasonable amount of summer pruning.

Thinning: During a normal season some varieties will set more fruit than the tree can possibly mature. Where this takes place thinning should be resorted to, as no tree can mature fruit of an even grade where crowding is allowed to continue. The period when fruit should be thinned will depend largely on climatic conditions, but it is as well to remember that it is the development of the pips or stone of the fruit that exhausts the tree most. To obviate this the work should not be left too late in the season. The grower himself should be the best judge, but the best time is usually from about the middle of November to the middle of December. Later in the season thinning may be carried out by picking any malformed or diseased fruit, as this will be of very little commercial value if left on the trees until the crop is ready to gather.

Summer pruning: This is a term that cannot be accepted in its broadest sense with reference to the treatment of trees during the growing-period. Although the practice of summer pruning is not and could not be generally recommended, much useful work can be done during that period, especially upon young trees. The various branches often commence growth on unequal terms. A watch should be kept for this, and the strong-growing branches slightly pinched. This will enable the weaker ones to catch up. In this manner it is possible to build up trees with an evenly balanced framework, which is most desirable. Apart from this judicious pinching, no summer pruning is recommended, as anything that reduces the leaf-surface during the summer is harmful to the tree.

FRUIT - CASES.

The matter of ordering a supply of cases should not be left until the crop is almost ready to gather. As soon as possible after an approximate estimate of the crop can be gauged an order for case timber should be placed with some reliable firm. It is quite unreasonable to expect any firm to turn out large orders at short notice. Supplies of box timber should be coming to hand during December. It will then be possible to utilize any spare moments

in making these up, and they will have sufficient time to dry before being used for fruit. It is a foolish practice to place fruit in green cases. Quite a large proportion of the trouble met with in the way of fruit opening up in bad condition is the result of using such cases.

SPRAYING.

Last season proved to be a very bad one for codlin-moth and leaf-roller. Recurrence of these troubles can be avoided only by carrying out a thorough system of spraying, commencing soon after petals have fallen and continuing at frequent intervals of not exceeding twenty-one-day periods up to the time of picking. The brands of arsenate of lead on the market are all more or less reliable if used correctly. The paste requires $1\frac{1}{2}$ lb. to 50 gallons of water, and the powder $\frac{3}{4}$ lb. The mixture should be kept well agitated while spraying is being carried out, in order to ensure an even distribution of the arsenate over the fruit and leaves. There will be no danger of burning if one uses the same weight of fresh-burnt lime reduced to milk of lime and strained into the arsenate of lead, always combining the two while they are highly concentrated.

A careful watch should be kept for the development of black-spot on apples and pears, and spraying carried out as directed in the *July Journal*.

Where powdery mildew is present atomic sulphur should be used in conjunction with lime-sulphur, at the rate of $\frac{1}{4}$ lb. to 6 lb. per 100 gallons; or, if used alone, 10 lb. to 100 gallons is necessary.

Where trees have been grafted a watch should be kept when the scion is beginning to swell, and care taken to loosen the material which has been used in tying the graft. If this is not done there is often a danger of the graft breaking off at this point.

--L. Paynter, Orchard Instructor, Christchurch.

CITRUS - CULTURE.

Seasonal work in citrus-groves will, in the main, consist of cross-ploughing, digging, and general cultivation thereafter; also the usual spring application of bordeaux, 4-4-40, for the control of verrucosis, as soon as the blossom-petals have fallen from the main flowering. In some cases, of course, this latter operation will already have been undertaken where the trees were sufficiently advanced.

Where brown-rot has been troublesome in the grove every precaution must be taken to remove the source of infection. All infected fruits should be removed from the trees, where they have not fallen, and any fruit and leaves on the ground should be removed to a safe distance from the grove, or buried to such a depth as to avoid the possibility of further spread. The spores of this disease spread rapidly in wet weather, and may be distributed even from a considerable depth under the surface of the soil when conditions are very favourable. It is therefore most likely that any infected fruit or leaves that are turned under in the digging beneath the trees may be responsible for further spread next season. Such development may be retarded to some extent by timely application of a proper spray-compound to the surface of the soil. This will be referred to at a later date, in due season.

FIREBLIGHT.

Orchardists in the Auckland District are accorded a protection under the provisions of the Fireblight Act in regard to hawthorn, where certain areas have been scheduled under that measure. Those districts outside, although at present free from this dreaded disease, are again warned that any relaxation of due vigilance in regard to the proper treatment of hawthorn near, around, or in their orchards may mean serious loss to them. Fruitgrowers generally throughout the Dominion are asked to communicate with the nearest Orchard Instructor immediately should any suspicious symptoms on plants susceptible to fireblight come under their notice.

—J. W. Collard, Orchard Instructor, Auckland.

. POULTRY-KEEPING.

END OF CHICKEN-HATCHING SEASON.

THE correct period for hatching out chickens has now passed, and poultry-keepers who have managed well will have the last of this season's birds in the brooder. No doubt many who have failed to hatch and rear the desired number of stock will continue to put down eggs for some time yet as a means of making up lost ground. Increasing the number of stock kept, however, does not necessarily mean increased profits; indeed, with the present high cost of foodstuffs the late-hatched birds may easily show a loss instead of a gain. In successful poultry-keeping strict attention to details is the great determining factor, and there is no matter of greater importance than the avoidance of having late-hatched stock on the plant.

DUCK-REARING.

Although the chicken-hatching season is now past, there is yet time to hatch out ducklings for the renewal of stock. Under proper management ducklings rapidly develop, and may therefore be hatched to advantage much later than chickens. Indian Runner ducks hatched now may be expected to lay during the next dear-egg season.

In mating Indian Runner ducks one male is usually allowed to six females. If strong robust ducklings are to be produced the parent birds should not be forced for egg-production. They should be well fed, but forcing-food such as meat should be sparingly supplied. Care must also be taken that they do not become overfat, as this is a common cause of infertile eggs and weakly stock. A mash of two parts pollard, one part bran, a half part maize-meal, and 5 per cent. meat-meal, with some finely chaffed lucerne, clover, &c., added, makes a suitable ration for breeding-birds. The amount of green material to include in the mash must be gauged by the manner in which the birds show their appreciation of it. If it is observed that they are leaving any in the food-trough it should be given in reduced quantity, or *vice versa*. Ducks should be always fed in troughs.

When food is thrown on the ground much of it will be wasted, besides which the practice has the effect of bringing the quarters into an insanitary, objectionable condition.

Incubating.—Ducklings can be hatched by artificial means in a somewhat similar manner to that employed for chickens. The temperature during the period of incubation, at the level of the tops of the eggs on the tray, should be 102° F. for the first week, from this on to the pipping-stage 103° , and 104° when hatching. If the correct degree of heat is maintained in the incubator the duckling will commence to pip on the twenty-sixth day, and hatch out on the twenty-eighth. Beware of the common mistake of trying to help the young ones out of the shell until they have been given their full time to hatch. When once the eggs have commenced to pip, the door of the incubator should not be opened until the hatch is practically cleaned up.

In general, duck-eggs do not retain their hatching-qualities as long as hen-eggs, and should therefore be placed under the incubator process as soon as possible after being laid. During the early stages of incubation duck-eggs require very little cooling. After the third day they should be turned, both morning and night. Usually the time taken to do this gives them all the cooling they require for the first week. During the second and third weeks the time of cooling should be extended by degrees up to twenty minutes or even half an hour, while during the last week they may be left out longer if the weather is favourable. The infertile eggs should be tested out after the fifth day, while frequent tests should be made to detect eggs containing dead germs. Such eggs rapidly decay and throw off a bad odour; therefore, unless removed promptly from the incubator, they are apt to injure the hatching-qualities of the remaining eggs. Usually the shell of a decaying duck-egg becomes discoloured and can be easily detected without the use of a tester. Duck-eggs require much more moisture than hen-eggs. A good way of applying this is to spray water at a temperature of 103° with the mouth on the eggs every morning after the fourteenth day. Do this after turning, and immediately place the eggs back in the machine. Do not cool after spraying. 'Spray in the morning and cool at night.

Rearing.—Ducklings are much easier to rear than chickens. If success is to be attained, however, several points must be strictly observed, some of which may be mentioned. The young birds should not be fed for thirty-six to forty-eight hours after hatching. In the first week the food may consist of equal parts of scalded bran and pollard, to which is added a small quantity of oatmeal and fine grit. Feed four times a day a quantity that the birds will pick up clean in about ten minutes. When the ducklings are about a week old the grit need not be mixed with the food, but it should be available to them in a shallow receptacle, so that they can help themselves. As the ducklings grow older the oatmeal can be eliminated from the ration (this being at the present time an expensive food) and maize-meal substituted. Finely cut green food, such as lettuce or young tender grass,

should be fed separately after the first week, while a little boiled minced meat should be given and increased by degrees as the ducklings develop.

Water should be given with the first meal, and from then onwards it should always be left in reach of the birds, both day and night. It is of the greatest importance that they be not given water after a long fast until they have received a meal. Even then it is a wise course to provide water with the chill taken off. Further, it is well not to let them drink to excess at the outset. Where ducklings are given a cold drink before food, and especially if they have been confined in a brooder without water, they are almost sure to suffer from staggers, with fatal results. Ducklings thus affected give every indication of being sunstruck, falling on their backs, with eyes twitching, and presenting a generally distressed appearance. They will sometimes behave in a similar manner, and with heavy mortality, when enclosed in an overhot, badly ventilated brooder. It should be always remembered that provision for an ample supply of fresh air at all times is one of the chief secrets in artificially rearing ducklings. Although ducks are water-fowl, it is imperative that their sleeping-quarters be maintained in the driest possible condition, or leg-weakness and other troubles will result. During the early brooder stage the drinking-vessels should be arranged so that the ducklings can merely get their bills into the water when drinking. This will prevent, to a great extent, bedding-material from getting wet. After, say, from three to four days the water-vessels should be placed in the brooder run, and well away from the sleeping-quarters, as a means of minimizing the wetting of the latter. At this stage the water-vessels should be of sufficient depth that the birds can wash off any food that adheres to their nostrils and at the same time give them a good blow-out. If the nostrils are allowed to clog, the eyes become plastered, while lameness, weak backs, and an unthrifty condition soon set in.

Young ducklings are very prone to sunstroke, and if not provided with good shade during hot weather mortality is likely to result. Care should be taken that the ducklings are well protected from their natural enemies, such as rats and stoats; these animals will attack them until they are fully three parts grown.

Marking.—It is important to mark ducklings as a guide to age, strain, &c., otherwise when culling-time arrives the young birds are apt to be weeded out instead of the old ones. An ordinary chicken-marker is unsuitable for this purpose, as the holes invariably grow out. The best way of placing a distinguishing mark on the duck's foot is to take a small, V-shaped piece out of the edge of the web of the foot. This should be done with a very sharp penknife, the foot of the duckling being held firmly on a piece of solid, smooth board during the operation. The ducklings can be marked when leaving the incubator, and with a register the different strains and ages can be distinguished at a glance, even when they are running together.

—F. C. Brown, Chief Poultry Instructor.

THE APIARY.

SWARMING.

By November, if the weather conditions are favourable, swarming should be in full swing throughout the Dominion. Therefore it is most important that the beekeeper should note the condition of his hives in ample time to decide which colonies are to be allowed to swarm. Excessive swarming is often accepted by beginners as a proof of prosperity, but this cannot be regarded by any means as an established fact. Only strong colonies headed by young vigorous queens should be allowed to swarm, and in many cases it will be found that these colonies show little inclination to do so. Where a colony of moderate dimensions persists in making preparations for swarming it should be deprived of its queen-cells at frequent intervals, and should be requeened from better stock at the earliest opportunity. When a strong colony swarms, the swarm should be hived at once into a clean box, in such a manner that the bees may pass in and out of the box easily, and be left there till towards evening. By that time a hive should be prepared containing frames fitted with full sheets of foundation, and, if necessary, a feeder. Place the hive on its permanent stand. Late in the afternoon the hive-body should be raised from the bottom-board and a clean sack laid on the alighting-board and surrounding earth. The bees should be dumped from the box on to the sack, when they will crawl into the hive. If honey is not coming in freely, or if bad weather supervenes, the swarm must be fed with syrup prepared from sugar and water, in the proportions of one to two, so that the bees may commence comb-building at once. Excellent combs are made from sugar-syrup, and within two or three days the bees should have drawn out several combs and the queen be busily engaged filling the cells with eggs. If possible, always use foundation when hiving a swarm. The bees in a swarm are prepared for comb-building, and will simply waste much wax if placed at once on drawn-out combs.

If the beekeeper has any reason to suspect the hive from which a swarm issues to be diseased, he should leave the swarm in the box into which he has hived it for at least three days, in order that the bees may use up the honey they will have brought with them when they left the parent hive.

After the swarm has issued, the parent hive should be thoroughly examined, so that the queen-cells may be removed. Every cell except two of the best should be taken away. Where the hive contains particularly good stock, and the queen-cells are large and ripe, they may be carefully preserved and placed in nuclei for the purpose of queen-raising. Very often the best queens in the apiary are procured by this means. When the swarm has been placed in its permanent hive the frames should be carefully covered by good mats. Neglect of this precaution, even for two or three days, will often result in the bees building comb right into the roof, especially where gable-roofs are used, thereby wasting much good material as well as making the hive difficult to open.

After-swarms.—It often happens that in spite of all precautions strong colonies will throw an after-swarm within a few days of the

issue of the prime swarm. Sometimes the prime swarm will be delayed by bad weather, in which case the bees may have kept the virgin queens in their cells until the laying-queen has left the hive, only to liberate them immediately after, and before the apiarist has time to examine for queen-cells. These queens, being small and quick-moving, are very difficult to detect, and will probably escape notice altogether. In this case the after-swarm may follow very quickly after the prime swarm. Occasionally, too, a few queen-cells may be missed in cutting out. If they are built, as frequently happens, on the edge of the comb against the side of the frame they are very easily overlooked. After a little observation an after-swarm can often be detected by its behaviour. A laying-queen is heavy with eggs, and will usually seek a resting-place without delay and without venturing too high from the ground. Sometimes, indeed, she falls to the earth, and the bees will be unable to find her and will return to the hive. However, she will usually alight in some convenient spot, and the bees will cluster round her with amazing rapidity. When the hives are scattered instead of being in regular rows, a beekeeper working in his apiary at a distance from a swarming hive may miss the whole operation of the issuing of a prime swarm unless the noise attracts his attention, so quickly, as a rule, do the bees settle with a laying-queen.

With one or more virgin queens in a swarm matters are usually different. The queens are small and light, and will often soar to a considerable height, choosing their own time about settling. If there are two or three queens in a swarm there will probably be as many divisions in the cluster, so that instead of forming one compact heart-shaped mass the swarm may hang for a considerable time in several peaks. Care should be taken to see that every section is shaken into the box. A simple method of dealing with after-swarms is to place an excluder between two empty hive-bodies, the lower of which rests on the ground or a bottom-board. Shake the swarm on to the excluder, when the bees will go through the holes in the excluder, and the queens may easily be distinguished and removed. When the queens are gone the bees will return to their parent hive, and the queens may be utilized for replacing old and failing queens. There need never be any doubt as to the advisability of taking every queen from an after-swarm—there will inevitably be one queen left in the hive for the bees to return to.

ARTIFICIAL INCREASE.

This may be accomplished in several ways, but perhaps the most satisfactory is by means of nuclei and division. A nucleus is best formed of two frames of emerging brood and young bees, one frame of honey, and one containing pollen. This must be completed by a virgin queen or a ripe cell. The nuclei may be utilized throughout the season for the mating of queens for renewal, and at the end of the summer, if two or more are united, or if each one is reinforced by the addition of bees and brood from strong colonies, they may be wintered in safety, and will form good stocks for the next season. No surplus can be expected from them in the year of their installation. In dividing it is best to wait till the colony is preparing to swarm and ripe queen-cells appear in the hive. The hive can then simply be

split in two by putting half the bees and brood on another stand, taking care to leave queen-cells in each division, and for preference putting as much emerging brood in the half which is to be placed in a new position. This latter precaution is necessary in order to make up the wastage from the field-bees that will return to the old stand. Each hive can then be completed by filling the vacancies by drawn-out combs. The queen-cells in the queenless half will be nursed by the young bees, while those in the half containing the queen will be torn down by the bees when they find the hive depleted. If the apiarist wishes to be quite sure of this being done he may search for the queen and remove her while the division is being made, afterwards putting her in the hive on the new stand. The division method is advocated on account of its simplicity and the fact that there is no necessity for finding the queen before the operation. It is a most effectual preventive of swarming, and saves a great deal of trouble where increase is desired.

SUPERING.

In most districts November is early enough for the employment of supers, though much depends on weather conditions. If the weather is warm, the hives full of bees, and nectar coming in freely, the supers may now be added at any time. However, it is of no use discouraging the bees by giving additional space before the weather is warm enough to justify it. If increase is required it is as well to confine the bees to one story till the hive is overflowing with bees. This is almost certain to produce a desire to swarm, and the hive can either be allowed to swarm naturally or be divided artificially. When the first super is put on it is best, if possible, to fill it entirely or partially with drawn-out combs. If only foundation is available, one or two combs—*not containing brood*—may be removed from the bottom story to the top, and sheets of foundation put in their place. On no account disturb the brood until settled weather occurs. If foundation is used in the super, queen-excluders should not be used, as the bees will rarely travel through the excluders to work the foundation and will usually swarm. Do not bring excluders into use until the bees are quite accustomed to working in the supers.

CARE OF BEE-YARD.

Before the supers are put on it is advisable to see that the hives are raised well above the ground, so as to provide ventilation underneath and also to prevent them becoming a shelter for insects. The bottom-boards should be raised to at least the height of a brick from the ground, and they may even be a little higher, though in the latter case the alighting-board should be long and sloping to enable the heavy-laden workers to reach the hive easily if, as so often happens, they miss the entrance when descending at the end of their homeward flight. All grass and weeds should be cleared away from the hives, particularly at the entrances. To save the continual labour of this operation during the spring and summer it is a good plan to skim the weeds from the ground and to spread agricultural salt in the proportion of about 6 lb. per hive, to prevent their reappearance for the season. Although this is only a temporary remedy, it should

save mowing the grass for at least one season. Whatever the labour, the entrances must be kept free; the bees' lives are all too short and arduous, and the energy wasted in forcing their way through the tangle of weeds sometimes seen in apiaries must amount to a good deal in the course of a season.

—*E. A. Earp, Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

THE gourd family of plants deserve more consideration from vegetable-growers in this country. Cucumbers, rock and water melons, marrows, squash, pumpkins, and ornamental kinds are included in this wonderful family. They require a light rich loam, heat, moisture, and proper treatment to give best results. In most districts and on many sections these conditions are available, and these varied and popular fruits can be in good supply for nine months in the year. In the colder localities the system of removing the top soil and putting in a foot or so of fermenting material and replacing the soil before sowing may be adopted. On such bottom heat, in a sheltered garden, surprising results can be obtained even in the coldest places. Ridge cucumbers may be planted 30 in. apart and 4 ft. between the rows, and other kinds wider as required. As soon as the plants are well established nip the growing points to make them stool out, after which little training will be required except to thin out growths that tend to crowd. Cut cucumbers and marrows while young, but melons, squash, and pumpkins must be allowed to ripen. Sow the seeds now, three or four in a clump, thinning them out later when they are well established.

Continue feeding and watering asparagus, rhubarb, and salads to keep them growing strongly. New asparagus-beds should be kept weeded, and the young plants encouraged to make strong growth in a natural manner. Carefully protect the foliage, specially where strong winds are experienced.

Sow leeks and celery—if they are not already in—and brussels sprouts, broccoli, savoy cabbage, and kale. In the warmer districts where growth is more rapid the sowing of these brassicas can be delayed till the third week in November. These sowings are of great importance and should receive every care, thus ensuring a varied and excellent crop of vegetables throughout winter and early spring. The plants will be ready for putting out into permanent quarters at the end of December and early in the New Year. In preparation, the ground to be planted should now receive attention; it can hardly be cultivated too deep or made too rich. Contrary to most other crops, which are somewhat dainty feeders, these crops require most generous treatment. More than any other crop does this one depend on the preparation of the land.

For kumaras select a piece of moist sandy loam in a warm locality. It should be clean and well worked. Apply the fertilizers and harrow them in a few days previous to planting, which may be

done now as soon as danger of hard frost is past. It is customary to throw the ground up in ridges $2\frac{1}{2}$ ft. apart, and set the plants 18 in. apart on the ridges. It is best to water them in if the weather should be dry.

When the weather has settled, plant out in a warm position egg-plants (aubergines, *Solanum melongena*) and capsicums (chilli-peppers). Plant them at 1 ft. to 18 in. apart, and grow them to one stem.

A few plants of tree-tomato (*Cyphomandra betacea*) might well be included where warm shelter can be given the plants. This is a perennial plant reaching a height of 6 ft. or 7 ft. or more in warmer localities in this country.

Thinning and hoeing seedling crops demands prompt attention. Hoe in bright weather and before the weeds get beyond the seedling stage of growth.

Tomatoes.

The planting of the outside crop of tomatoes will now be in general operation, and the remarks under this heading given last month will apply. Plants in doubtful condition may be sprayed with bordeaux, 3-4-50, while still in the boxes. If lime is not available 6 lb. of washing-soda may be substituted.

Under glass, the stopping of laterals and the training of plants on the strings should be attended to promptly. Occasionally one finds growers giving deep cultivation at this season, which is a great mistake. The fibrous roots are close to the surface and should not be disturbed; hoeing should be only deep enough to destroy weeds. In some houses leaf-mould (*Cladosporium*) is already making its appearance. In such cases steps should be taken to deal with it immediately. Ventilation is a big factor in this problem. Give abundant top ventilation in fine weather and commence at day-break. Sudden high winds sometimes makes the working of a number of ventilators difficult, but if they are built of light material and securely fixed there should not be many breakages. At this stage apply bordeaux at the first sign of fungus trouble. Occasionally a plant or two is found badly affected with Fusarium wilt. As this is a root trouble, lift the affected plants with roots intact, and remove and destroy them, watering the soil from which they have been taken with a solution of iron sulphate, 1 lb. to 15 gallons of water.

Towards the end of November the first bunch of fruit on the plants will be ripening under glass. The surrounding foliage may then be removed and a straw mulch applied. When picking has commenced, in addition to necessary watering, apply also liquid manure at intervals of a fortnight or so. This is usually composed of suitable quantities of superphosphate, sulphate of potash, and nitrate of soda.

SMALL-FRUITS.

The harvesting of gooseberries and strawberries will be taking place during the coming month. With the latter crop especially it is desirable to avoid extra handling as much as possible. Sorting can be avoided if the pickers are instructed to place jam fruits in a separate receptacle to the dessert fruits. Growers should carefully study the new regulations

regarding the packing of strawberries, &c., which are summarized at foot of this page.

Young passion-vines planted out recently should be kept growing strongly. Stop lateral growth by pinching out the growing point until the vine reaches the top wires. On old passion-vines the summer crop is often sacrificed by pruning back the bearing laterals, and so augmenting the winter crop, which is more valuable. Such pruning is usually performed towards the end of November.

THE COMPOST-HEAP.

Where seedlings have to be raised in boxes annually a good compost-heap is the foundation of success. Gardeners should commence to lay that foundation now by securing a quantity of good turfy loam—from an old pasture, if possible. Stack it in the open, with the grass down, in a compact heap to decay and mellow. The old hot-beds can be placed under cover and turned occasionally; they will form a useful ingredient. It is advisable to commence preparing the materials now; there is little enough time to get them into condition before next season.

TOBACCO-GROWING.

The sooner tobacco-plants are put out now the better. Fill gaps in the planting as soon as they occur. Keep the horse-hoe busy weeding, and maintain a good, shallow tilth. When the plants become big, hand-hoeing will have to be resorted to. When the majority of the plants develop their flower-buds the plants should be stopped by carefully pinching them out. This has the effect of throwing the strength of the plant into the leaves, which quickly increase in size and thickness. Another effect is the development of laterals in the axils of the leaves. They also must be removed as soon as they are large enough to handle.

LAWNS AND PLAYING-GREENS.

Lawns and playing-greens will now be making rapid growth, and will require a great deal of attention. Cutting must be attended to regularly, and the worst weeds, at least, taken out. Give abundant rolling when the turf is moist, specially if the land be light. It will go a long way towards checking the injury sometimes caused at this season by the grass-grub, besides effecting a general improvement.

—*W. C. Hyde, Horticulturist.*

REGULATIONS AS TO PACKING OF FRUIT.

REGULATIONS gazetted on 11th September prescribe that strawberries, loganberries, raspberries, and cherries sold or offered or exposed for sale in a container shall be packed in such a manner that any fruit exposed to view shall fairly represent in size, maturity, and condition the whole contents of the container, and that the container shall be full of fruit. Nothing in the regulations is to be held to prohibit "facing"—that is to say, the methodical arrangement of the individual fruits that are exposed to view in a container—provided the previously stated requirements are complied with. "Container" is defined as meaning any package of a capacity not exceeding 3 lb. net weight of the fruit contained therein. The penalty for breach of the regulations, on conviction, is a fine not exceeding £20.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

HAND-REARING LAMBS.

"DOUBT," Walton :—

Would you kindly advise the best way of hand-feeding lambs?

The Live-stock Division :—

Lambs whose mothers have died can be reared successfully on cow's milk. The milk should be from a cow rich in fat—as ewe's milk is high in fat—or cream may be added. During the first few days and nights a small amount of milk only should be fed—say, two or three tablespoonfuls at a time but it must be fed often, every two or three hours. The milk should be fed from a bottle, with a medium-sized nipple attached, and should always be warmed to approximately 100° F. (blood-heat). The bottle and nipple should be carefully washed after each feeding. When the lamb is two or three weeks old it is not necessary to feed more than three times a day.

PRECAUTIONS AGAINST MAMMITIS.

F. S. METCALFE, Matakohe :—

Please inform me if Condy's crystals added to water for washing cows' teats is a preventive against contagious mammitis, and at what strength it should be used. Failing Condy's, what could you recommend as a prevention?

The Live-stock Division :—

While washing cows' teats with a solution of Condy's fluid is a step in the right direction, it will not prevent the animal from contracting mammitis. In addition to washing the teats the milking-machines should be thoroughly cleaned after each milking, and, while milking, the teat-cups should not be put on an animal suffering from the disease and afterwards placed on another animal. This would spread the disease throughout the herd. If a little milk is drawn on the palm of the hand from each teat before milking, any clots or other abnormality can be noticed, and cows showing any departure from the normal should, until recovery takes place, be milked by hand. The trouble with the majority of antiseptics used for cleansing the udder and milking-machines is that they are apt to taint the milk. For cleansing purposes a 5-per-cent solution of boracic acid can be used with advantage. As a preventive measure it is necessary that the surroundings be kept thoroughly clean.

SURFACE-SOWING OF CLOVER-SEED IN GRASSLAND.

"DIGGER," Masterton :—

Please advise me if it is an economical proposition to mix a little clover-seed with superphosphate when top-dressing hill pasture which is inclined to run out, and, if so, what variety, and how much? The pasture originally was rye-grass and clovers, but is gradually giving way to *Danthonia*, *fiorin*, and sweet vernal.

The Fields Division :—

We would certainly advise you to do as suggested, provided the clover-seed and manure are sown immediately after mixing—say, the same day. Do not sow until after danger of frosts is over, as the young clover-plant is easily heaved out; also arrange to have the pasture fairly well eaten down, so that the seed will have a fair chance of reaching soil before germination takes place. If it were possible to drive a mob of sheep behind the sowing this would greatly enhance the chances of a good take. Both cow-grass and white clover can be introduced in this manner. From 3 lb. to 4 lb. of cow-grass and 1 lb. to 2 lb. of white clover per acre are suggested.

BUTTERFAT CONTENT OF WHEY.

W. G. THOMAS, Carterton :—

Kindly advise whether the butterfat content of a sample of whey from high-testing milk in cheesemaking would be greater than a similar sample of whey from low-testing milk.

The Dairy Division :—

The percentage of fat in whey from whole milk is a fairly constant amount, being around 0.27 per cent., whatever the fat content of the milk, because the fat lost is due to the unavoidable injury to the coagulated milk when it is cut with a knife in order to free the whey from the curd. With high-testing milk the loss of fat in the whey is lower per pound of fat in the milk than with low-testing milk.

LICE ON HORSES.

"NOVICE," Te Awamutu :—

Can you recommend treatment for a horse infected with lice, with the skin becoming scaly and rubbing off? The horse was covered all winter, and (at date of writing) is still being covered.

The Live-stock Division :—

All horses are subject to infection from lice, no matter what condition they may be in; but the lice, by their continual irritation of the animal, tend to reduce his condition. For treatment, first have the horse clipped all over; then, upon a suitable day, apply a dressing all over the body, care being taken to see that the mane and tail are most thoroughly attended to. At the same time the rug which has been in use upon the animal should be steeped for half an hour in a strong solution of sheep-dip, and hung upon a fence to dry. If this is not done the rug will again infect the horse, or, if used upon another before being disinfected, will carry infection to it. One dressing usually destroys all the lice, but in a few days' time the eggs which have not been destroyed hatch, with the result that if not attended to the animal will soon be as bad as ever. Herein lies the common failure to cure, as this second crop of lice, if not at once destroyed, set about propagating, and they must be destroyed before they have time to do so. The dressing should therefore be repeated in seven days, and if any lice are found in the following week a further treatment given, the rug receiving the same attention. The usual applications are any of the non-poisonous sheep-dips, sulphur ointment, or 4 oz. of stavesacre-seed to the gallon water, which has been boiled for one hour. A good dressing, after the skin has been prepared, consists of one part of kerosene and eight parts of fish-oil. In two days as much as possible of the dressing should be scraped off with a piece of hoop-iron, otherwise the animal will become very dirty if exposed to dust. When a horse infected with lice has been clipped, the clippings should be swept up and burnt. The foregoing treatment is also applicable to cows.

MAKING BORDEAUX MIXTURE.

"INQUIRER," Auckland :—

In making bordeaux mixture, if more lime than bluestone is used, does it make the mixture weaker than if equal quantities of lime and bluestone are used? For instance, if I make a mixture 4-4-40, and it tests alkaline, would the addition of 2 lb. extra of lime—making it a 4-6-40 mixture—make the latter weaker than the 4-4-40?

The Horticulture Division :—

The addition of an excessive amount of lime in the making of bordeaux mixture retards the fungicidal action of the spray and reduces its adhesive qualities. The mixture is at its best when neutral or only slightly alkaline.

GROWING LUPINS FOR SOIL-IMPROVEMENT.

"T. A. H.," Matamata :—

I have a piece of somewhat sandy land, and understand that lupins ploughed in will improve this class of soil. Will you please give me information as to varieties, time to sow, &c. ?

The Fields Division :—

There are two varieties of lupins in common use. The blue lupin (*Lupinus angustifolius*) is the most suitable for clay soils, exposed situations, and cold climates. The white lupin (*Lupinus albus*) is the best for light soils, but is less hardy, and generally requires to be sown in spring. It should suit your land and district. Sow any time from mid-September to mid-December, using 2½ bushels per acre for broadcasting, or 2 bushels per acre for drilling. After broadcasting, disk once, and level off with the harrows. If sown on level-crested ploughing, a few strokes of the tines will be enough. If drilled, the seed should be buried about 1 in. deep. Unless your land has been recently manured and is in good condition, it will pay you to use 2 cwt. to 3 cwt. per acre of super or basic super, sown at the same time as the seed. This will greatly enhance the value of the crop as a soil-improver. Plough in as the crop commences to flower.

DESTROYING VARIEGATED THISTLES.

"SUBSCRIBER," Wairoa :—

Kindly advise me whether cutting variegated thistles at this time of year will be effective. The thistles have made phenomenal growth during the winter and are now nearly half-grown. There are, however, numbers of small ones. I propose cutting them now level with the ground. I should appreciate your opinion as to whether they will grow again or not this season.

The Live-stock Division (Noxious-weeds Inspection) :—

If the thistles are chipped off below the crown of the plant they will not grow again. If the cutting is done above the crown of the plant they will sprout up again and go to seed. Therefore it is necessary to chip them off with a hoe or other instrument below the crown

SUGAR-BEET FOR FEEDING COWS.

L. R. CRAIG, Ngaere :—

Please inform me on the possibilities of sugar-beet as a feed for dairy cows ; also when and how to grow this crop.

The Fields Division :—

Tests made at the Stratford Demonstration Farm for two seasons indicate that an average crop of 16 tons to 18 tons per acre of sugar-beet may be expected in your district, as compared with 25 tons nearer the coast. The seed should be sown about the same time as mangolds—from the end of October until the middle of November—in drills 14 in. to 21 in. apart, at 5 lb. to 6 lb. per acre ; manure, three parts super, two parts bonedust or Nauru phosphate, two parts kainit, used at the rate of 4 cwt. to 6 cwt. per acre. When the plants are 3 in. to 6 in. high thin out to 9 in. apart in the rows. The roots should be pulled when they finish growing, about June, and stacked in the same way as mangolds, to allow them to properly ripen, when cows and pigs are very fond of them. Sugar-beets have a feeding-value of roughly two-thirds more than mangolds, the ratio being about 9 to 15. On the other hand, you should get double, and in most cases three times, the weight of mangolds per acre ; besides which, mangolds are easier pulled and handled. So far as your district is concerned, mangolds should be a much better proposition for feeding cows than sugar-beet.

The Wyndham Agricultural and Pastoral Society (Southland) was formally incorporated by Order in Council dated 11th August, 1924.

WEATHER RECORDS : SEPTEMBER, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

SEPTEMBER was, on the whole, a mild and seasonable month. There were three or four stormy periods. On the 7th, 8th, and 9th a tropical disturbance passed from the north to the east, and barometric pressure ranged over the Dominion as low as from 29.10 in. to 29.50 in. on the 8th, and brought good rains, especially in the northern districts. Westerly disturbances passed on the 15th and 16th, and a very unsettled westerly spell held sway in the South from the 22nd to the 28th. This was most beneficial in Canterbury and Otago—the breaking-up of a dry period. Rainfall was abundant on all the western coast owing to the prevalence of moist winds, but reports on all the eastern coast, except Canterbury, continue to show the deficiencies which have prevailed in former months.

Barometric pressure was above normal in the North during the greater part of the month, and very unsteady in the South.

Christchurch observatory reports the warmest September since 1917, and rainfall only 47 per cent. of the average for the month. New Plymouth observatory notes that the month was very cloudy and with less bright sunshine than any month for several years; the rainfall was heavier than usual, but the ground-temperature was high.

The high stations in the South Island had heavy rains; at Arthur's Pass 17.98 in., and at Otira 21.12 in., fell during three spells of wet weather.

D. C. Bates, Director.

RAINFALL FOR SEPTEMBER, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average September Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitia	4.34	9	2.22	4.75
Russell	4.10	10	1.38	3.42
Whangarei	4.37	13	1.57	4.88
Auckland	4.18	13	1.86	3.62
Hamilton	5.11	20	1.08	4.37
Kawhia	4.32	15	1.16	4.39
New Plymouth	5.41	20	1.73	5.08
Inglewood	12.31	20	2.86	9.48
Whangamomona	6.88	16	1.35	7.57
Tairua, Thames	6.98	11	2.24	4.64
Tauranga	4.25	14	1.35	4.21
Maraehako Station, Opotiki	6.52	14	2.30	4.28
Gisborne	1.02	7	0.48	3.11
Taupo	4.60	12	1.22	3.71
Napier	0.90	6	0.31	1.75
Maraekakaho Station, Hastings	1.53	9	0.45	2.58
Taihape	2.90	14	0.64	3.72
Masterton	2.53	11	0.83	3.18
Patea	3.76	16	0.97	3.63
Wanganui	2.84	13	0.70	3.05
Foxton	2.80	14	..	2.37
Wellington	2.45	11	0.63	4.05
<i>South Island.</i>				
Westport	3.87	18	0.73	6.82
Greymouth	5.41	16	1.21	8.26
Hokitika	10.72	19	2.06	9.14

RAINFALL FOR SEPTEMBER, 1924—*continued.*

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average September Rainfall.
<i>South Island—continued.</i>				
	Inches		Inches.	Inches.
Arthur's Pass	17·98	14	4·56	14·96
Okuru, Westland	14·92	16	2·00	12·48
Collingwood	5·79	16	1·33	10·13
Nelson	3·30	14	1·82	3·75
Spring Creek, Blenheim..	1·51	8	0·43	2·64
Tophouse	4·92	13	1·92	4·81
Hanmer Springs	1·43	7	0·72	4·58
Highfield, Waiau	0·77	7	0·22	3·35
Gore Bay	0·38	4	0·17	4·28
Christchurch	0·98	7	0·65	1·75
Timaru	0·98	5	0·64	2·18
Lambrook Station, Fairlie	0·98	4	0·48	2·30
Benmore Station, Omarama	2·40	8	1·16	2·14
Oamaru	1·73	13	0·55	1·74
Queenstown	3·06	9	0·83	2·52
Clyde	1·20	6	0·65	1·06
Dunedin	2·56	9	1·04	2·74
Gore .. .. .	..	..	..	2·44
Invercargill	3·29	16	0·82	3·00

BOOKS RECEIVED.

"FARMERS' FOES IN NEW ZEALAND, AND HOW TO COPE WITH THEM," by F. W. Hilgendorf, Lecturer on Biology, Canterbury Agricultural College, Lincoln, N Z ; 82 pages ; illustrated ; price, 3s. 6d ; Whitcombe and Tombs, Auckland, &c. Latest issued volume of the "New Zealand Practical Handbook Series" ; treats of insect pests, animal parasites, &c.

"AGRICULTURE : THE SCIENCE AND PRACTICE OF BRITISH FARMING," by James A. S. Watson, Professor of Agriculture, University of Edinburgh, and James A. More, Lecturer on Agriculture, University of Edinburgh ; 656 pages ; illustrated ; price, 15s. net, Oliver and Boyd, Edinburgh and London. A new text-book for students, covering the soil, crops, live-stock, and farm management.

GUM-TREE-SCALE SPECIMENS: A CAUTION.

IN view of the rapidity with which the gum-tree scale or blight spreads, and of the destruction it causes to eucalypts, the attention of residents in the scale-infested areas is drawn to the necessity of exercising the greatest care when sending living specimens of this blight through the post, either to Wellington or to any other district outside an infested area. In order to avoid the possibility of spreading the blight in this manner, any specimens for transmission should first be sent to a local officer of the Department of Agriculture, who will forward them preserved in methylated spirits if necessary.

New Rabbit District.—The constituting of the Turanga-o-Moana Rabbit District, Matamata County, for the purposes of Part III of the Rabbit Nuisance Act was gazetted on 9th October.

ANNUAL SHEEP RETURNS AS AT 30TH APRIL, 1924.

TABLE I.—SUMMARY BY SHEEP DISTRICTS.

Class.	Auckland.	Napier-Gisborne.	Wellington-West Coast.	Marlborough-Nelson-Westland.	Canterbury-Kaikoura.	Otago (including Southland).	Total in Dominion.
Stud rams ..	715	817	3,621	894	3,144	2,817	12,008
Other rams ..	25,599	85,896	69,403	17,210	68,174	54,524	320,806
Wethers ..	275,537	576,616	648,710	205,434	492,080	608,055	2,807,032
Breeding-ewes ..	1,031,047	3,339,805	2,758,097	671,877	2,881,047	2,374,221	13,076,094
Dry ewes ..	69,787	366,607	244,412	45,614	174,620	145,410	1,046,450
Lambs ..	545,430	1,908,176	1,508,442	331,504	1,092,030	1,127,804	6,513,386
Totals, 1924 ..	1,968,115	6,277,917	5,232,685	1,272,533	4,711,095	4,313,431	23,775,776
Totals, 1923 ..	1,737,857	6,022,333	5,049,473	1,266,533	4,651,658	4,353,585	23,081,439

TABLE II.—COMPARATIVE STATEMENT: TEN YEARS, 1915-24

Year.	Stud and Flock Rams.	Stud Breeding-ewes.	Stud Dry Ewes.	Stud Lambs	Total Stud Sheep and Flock Rams.	Sheep of Distinctive Breed not entered in Flock-books, and Crossbred Sheep.			Grand Total, Stud and other Sheep.
						Wethers.	Breeding-ewes.	Dry Ewes.	
1915	315,251	237,717	17,341	176,556	746,865	3,270,221	12,377,624	1,365,119	24,901,421
1916	316,131	252,201	15,012	175,155	758,499	3,478,263	12,640,566	1,189,023	24,788,150
1917	329,230	160,212	6,212	114,778	610,432	3,457,824	13,099,957	1,066,435	25,270,386
1918	325,111	171,437	6,297	125,116	627,961	3,096,520	12,850,597	1,592,452	26,538,302
1919	321,304	165,676	12,196	127,150	626,326	3,922,632	12,170,224	1,799,201	25,828,554
1920	306,621	154,516	9,803	109,454	580,394	3,901,742	11,415,159	1,814,391	23,919,970
1921	322,144	158,608	9,513	110,428	600,693	3,634,799	11,989,180	1,336,306	23,285,031
1922	322,072	154,277	7,259	98,221	581,829	2,727,624	12,341,777	952,789	22,222,259
1923	330,055	172,843	9,013	119,749	631,660	2,551,627	12,890,160	808,919	23,081,439
1924	332,814	179,533	9,727	132,137	654,211	2,807,832	12,896,501	1,036,723	23,775,776

NOTE.—Stud sheep returned since 1917 are only those entered in flock-books.

TABLE III.—DISTRIBUTION OF THE VARIOUS BREEDS AND OF CROSSBREDS IN EACH SHEEP DISTRICT (1924).

Breed.	Auckland.	Napier-Gisborne.	Wellington-West Coast.	Total in North Island.	Marlborough-Nelson-Westland.	Canterbury-Kaikoura.	Otago.	Total in South Island.	Total in Dominion.
Stud sheep (entered in flock-books)—									
Merino ..	..	..	..	..	10,003	14,402	4,074	28,479	28,479
Lincoln ..	1,491	3,102	10,872	15,525	579	189	1,099	1,867	17,392
Romney ..	12,779	12,700	78,558	104,097	9,549	4,091	34,373	48,013	152,110
Border Leicester ..	189	..	536	725	324	11,159	10,764	22,247	22,972
English Leicester ..	584	622	412	1,618	1,200	19,105	923	21,408	23,026
Shropshire ..	512	..	587	1,099	149	1,846	515	2,510	3,609
Southdown ..	1,430	6,753	16,479	24,662	354	9,414	617	10,385	35,047
Corriedale ..	19	..	922	941	734	31,430	6,458	38,622	39,563
Other breeds ..	127	137	342	606	929	8,389	2,285	10,601	11,207
Totals ..	17,131	23,434	108,708	149,273	23,911	100,115	60,106	184,132	333,405
Sheep of a distinctive breed but not entered in flock-books—									
Merino ..	6,425	15,221	19,475	41,121	101,179	365,189	277,790	834,158	875,279
Lincoln ..	7,687	60,023	36,950	104,660	5,986	1,141	7,420	14,547	119,207
Romney ..	238,107	1,190,975	1,047,686	2,482,768	143,380	64,831	307,488	515,699	2,998,467
Border Leicester ..	3,798	2,552	2,608	9,018	1,545	24,214	61,797	87,556	96,574
English Leicester ..	3,232	1,179	1,120	5,531	7,040	32,556	5,500	45,096	50,627
Shropshire ..	3,002	97	1,717	5,416	1,553	4,793	1,228	7,574	12,990
Southdown ..	3,802	13,936	28,690	46,428	2,334	5,196	345	7,875	54,303
Corriedale ..	1,248	566	28,334	30,148	5,505	321,313	285,750	612,634	642,782
Half-breeds ..	3,395	1,396	7,720	12,520	206,038	893,215	275,715	1,434,968	1,447,488
Other breeds ..	670	1,630	1,608	3,908	2,035	819	8,700	11,554	15,462
Totals ..	271,966	1,293,575	1,175,977	2,741,518	620,655	1,713,267	1,231,739	3,571,661	6,313,170
Crossbreds and others not otherwise enumerated	1,679,018	4,960,908	3,948,000	10,587,926	621,967	2,897,713	3,021,586	6,541,266	17,129,192
Grand totals ..	1,968,115	6,277,917	5,232,685	13,478,717	1,272,533	4,711,095	4,313,431	10,297,059	23,775,776

FORTHCOMING AGRICULTURAL SHOWS.

Marlborough A. and P. Association : Blenheim, 22nd and 23rd October.
 Hawke's Bay A. and P. Society : Hastings, 22nd and 23rd October
 Auckland A. and P. Society : Auckland, 24th and 25th October.
 Poverty Bay A. and P. Association : Gisborne, 28th and 29th October.
 Wairarapa A. and P. Society : Carterton, 29th and 30th October.
 Whangarei A. and P. Association : Whangarei, 29th and 30th October.
 Manawatu A. and P. Association : Royal Show, Palmerston North, 4th, 5th, and 6th November.
 Ashburton A. and P. Association : Ashburton, 6th November.
 Canterbury A. and P. Association : Christchurch, 13th and 14th November.
 Egmont A. and P. Association : Hawera, 19th and 20th November.
 Wallace A. and P. Association : Otautau, 19th November.
 Waikato A. and P. Association : Hamilton, 19th and 20th November.
 Stratford A. and P. Association : Stratford, 26th and 27th November.
 Hauraki A. and P. Association : Paeroa, 26th and 27th November.
 Southland A. and P. Association : Invercargill, 9th and 10th December.
 Woodville A. and P. Association : Woodville, 20th and 21st January.
 Waimarino A., P., H., and I. Association : Raetihi, 22nd January.
 Pahiatua A. and P. Association : Pahiatua, 30th January.
 Clevedon A. and P. Association : Clevedon, 7th February.
 Te Puke A. and P. Association : Te Puke, 12th February.
 Dannevirke A. and P. Association : Dannevirke, 11th and 12th February.
 Northern Wairoa A. and P. Association : Mititai, 17th and 18th February.
 Masterton A. and P. Association : Solway, 17th and 18th February.
 West Coast A. and P. Association : Greymouth, 18th and 19th February.
 Rotorua A. and P. Association : Rotorua, 20th February.
 Waiapu P. and I. Association : Ruatorea, 25th and 26th February.
 Tauranga A. and P. Association : Tauranga, 26th February.
 Franklin A. and P. Association : Pukekohe, 27th and 28th February.
 Omaha and Pakiri A. and H. Association : Leigh, 28th February.
 Taumarunui A. and P. Association : Taumarunui, 4th March.
 Waikato Central A. Association : Cambridge, 4th and 5th March.
 Mangonui A. and P. Association : Mangonui, 6th and 7th March.
 Morrinsville A., P., and H. Society : Morrinsville, 11th March.
 King-country Central A. and P. Association : Te Kuiti, 12th March.
 Matamata A. and P. Association : Matamata, 19th March.
 Mayfield A. and P. Association : Mayfield, 21st March.
 Temuka and Geraldine A. and P. Association : Winchester, 2nd April.

Agricultural and Pastoral Association Secretaries are invited to supply dates and location of their shows for publication in this list.

Weraroa Sale of Pedigree Stock.—The annual sale at the Central Development Farm, Weraroa, which took place on 1st October, drew a good attendance, buyers being present from many parts of the Dominion. The demand for Friesian cattle was slack, a number of lots being passed; bulls sold brought up to 41 guineas, and cows 30 guineas. Red Poll cattle sold well under brisk competition, bulls realizing up to 125 guineas, and females up to 80 guineas. A good demand was experienced in the pig section. Berkshires realized up to 10½ guineas for boars, and 14½ guineas for sows; Large White boars to 10½ guineas, and sows to 20 guineas; Large Black boars to 10 guineas, and sows to 20 guineas.

State Sales of Trees and Tree-seeds.—The disposals of forest-trees and forest-tree seeds to farmers, settlers, local bodies, proprietary and co-operative companies, &c., from the State Forest Service nurseries during the last five financial years were as follows: Trees in 1920, 277,235; 1921, 520,702; 1922, 897,552; 1923, 1,475,581; 1924, 1,839,512. Seeds—1920, 130 lb.; 1921, 240 lb.; 1922, 436 lb.; 1923, 746 lb.; 1924, 618 lb.



The New Zealand Journal of Agriculture.

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WELLINGTON, 20TH NOVEMBER, 1924.

THE INTERNAL STRUCTURE OF WOOL.

ITS SIGNIFICANCE FOR SHEEP-BREEDERS.

A. H. COCKAYNE, Director of the Fields Division, Wellington.

DURING the past year the view has been expressed by certain English wool-spinners that the quality of those New Zealand wools that are dominantly of a Romney character are deteriorating in quality. If such were the case it would be of very considerable significance to our wool industry, as the Romney is numerically our most important sheep, and Romney and Romney-cross wools constitute the major portion of our annual clip. It was therefore decided to carry out some investigations into the structure of New Zealand wools in general and that of Romney wool in particular. The object was to ascertain if possible what were the actual structural defects in the fibres that were apparently causing some at least of our wool to be held in low esteem by overseas manufacturers, and whether such defects were confined to the Romney or were also present in other breeds. In connection with this investigation, which so far has been confined to the actual internal and external structure of the wool-fibre itself, I have to express my very great thanks for assistance rendered me by Professor Cossar-Ewart, of Edinburgh, during his visit to New Zealand last year, and by Mr. William Perry, the well-known Romney breeder, whose practical advice has been invaluable.

Right from the commencement of the investigation it was recognized that in the wool trade there are a large number of terms in regular use, all of which are connected with peculiarities of structure.

Among such terms are "character," "crimp," "harshness," "softness," "free-handling," "quality," "lustre," and "tip." These terms are well known and used by sheep-breeders. The actual structural peculiarities of the individual fibres that lead to variation in the wool characteristics of the fleece and have given rise to all these terms are, however, comparatively very little known. As it is the actual structure of the fibres themselves that determine whether a wool is harsh or soft, free-handling or the reverse, it is clearly advisable to learn all that is possible about the structure of New Zealand wools, and for wool-growers to eliminate as far as possible those structural defects that are likely to lead to deterioration in quality.

Before dealing with certain phases of the structure of wool it is necessary to state just what wool is, and in what respects it differs from other animal-fibres. There are three great types of animal-fibres used for clothing and other domestic purposes—namely, hair, wool, and fur. Much speculation has been pursued in the past as to whether these three types of fibres have been evolved from a single stock, or whether they each represent structures in no way related to each other. When typical hair, wool, and fur are compared together they show many outstanding differences; on the other hand, there are many animal-fibres that possess the essential characters of both hair and wool, and of hair, wool, and fur, so that it is often difficult to draw any hard-and-fast line of distinction between any of these groups.

A typical hair consists of a central strand of rather spongy thin-walled cells surrounded by a mass of closely packed fusiform cells, which in turn are jacketed with a single layer of flattened cells, the edges of which are closely pressed together, presenting a perfectly smooth and uniform surface. The central strand is termed the "pith" or "medulla." The tissue surrounding the medulla is termed the "cortex," and the cells composing the outer layer are termed the "scales."

A fur-fibre possesses all these three types of tissue, but the medulla is generally even more developed than in ordinary hair, and the scales, instead of being closely pressed together, often have their upper edges quite free and stand out slightly from the surface of the fibre. In true wool the medulla or central strand is or should be absent, the whole of the tissue, with the exception of the enveloping scales, consisting of cortex material. The scales, again, are very characteristic, the upper portion of each one being free, and turning slightly outwards, allowing an easy entrance and exit of materials to and from the cortical tissue. This gives the fibre a serrated appearance, and very frequently the word "serration" is used to express this peculiarity, the term being in reality synonymous with "scale." Not infrequently "serration" is used to express crimp or curl, but the use of the word in this connection is quite incorrect. Another very important characteristic of animal-fibres is whether they will felt or not. In this respect true hair belongs to the class of non-felting fibres, while both fur and wool can be felted. At one time it was considered that the serrated exterior of the wool and fur fibre was the actual cause of felting taking place, but since it has been shown that certain serrated fibres will not felt, and certain non-serrated ones felt readily, doubts on the validity of this theory have been expressed.



FIG. 1. HAIR, SHOWING CENTRAL STRAND AS MEDULLA. MAGNIFIED 400 DIAMETERS.



FIG. 2. WOOL-FIBRE, SHOWING NO MEDULLA AND OUTER SCALES. $\times 400$.

[Microphotos by Biological Laboratory.]

From what has been written it can be seen to be difficult to exactly define wool from other animal-fibres. If one takes felting-property as a criterion, this falls to the ground, as both fur and certain hair possess this characteristic. The presence of serration is not confined to wool, being regular in many furs. The absence of a medulla or central strand is perhaps the best single criterion as to whether a fibre is wool or not, but here, again, if this were rigidly interpreted many apparently true wools would have to be classed as hair.

The fact that there is no single structural feature that always distinguishes wool from either hair or fur, and no feature always distinguishing fur from hair, rather indicates that both wool and fur represent modified hair, and have been gradually evolved from hair in the distant ages of the past. A very regular feature of many wild animals is the production of a double coat of fibres, one much longer than the other and typically hairlike in character, and the other an undergrowth of much finer fibres possessing many wool characteristics. In primitive sheep this feature is quite regular, and even in such a breed as the Merino the new-born lamb possesses a more or less double coat of hair and wool. Again, many species of goats that are supposed to produce only hair have a well-developed undercovering of serrated non-medullated fibres that cannot be classed as anything but wool. It would appear as if in the domesticated breeds of sheep the skill of the breeder has more or less eliminated the true hair coat and developed

a fleece consisting only of underwool, but in many cases this under-covering may not consist of fibres that are of a true wool type. It is perhaps possible that in the dense wools, such as Merino, the fleece represents underwool with complete elimination of the hairy overcoat, while in the long wools the fleece may represent the modification of the hairy overcoat into wool.

FOUR TYPES OF FIBRES.

Examination of any long-woolled sheep, such as the Romney or Lincoln, shows that four types of fibres may be present—namely, (1) face and leg hair, (2) kemps, (3) medullated wool-fibres, and (4) non-medullated wool-fibres (true wool).

Face and leg hair : These are of true hair type, containing medulla, cortex, and scales closely pressed on to the cortex, the whole fibre often flattened more or less in outline, and short and pointed. Very considerable variation in the harshness or softness of these hairs can be noted even by the hand. Wherever the fibres are more or less circular in outline and show distinct signs of serration they are soft to the touch, and softness of face and leg hairs is apparently always connected with absence of kemps and absence of medullated wool-fibres.

Kemps : These, of course, are well known to all sheep-breeders, and are likely to be found in all breeds, the long wools being no worse in this respect than the short wools. Kempes are structurally almost indistinguishable from face and leg hair, but are more slender and longer, though generally much shorter than the average wool-fibres ; also like the face and leg hairs, they have a limited life, shedding themselves and not continuing to grow from year to year as in the case of wool. The presence of kemps is, of course, quite objectionable from the manufacturer's standpoint, but New Zealand wools are by no means conspicuous in the amount of kemps they contain. In fact,

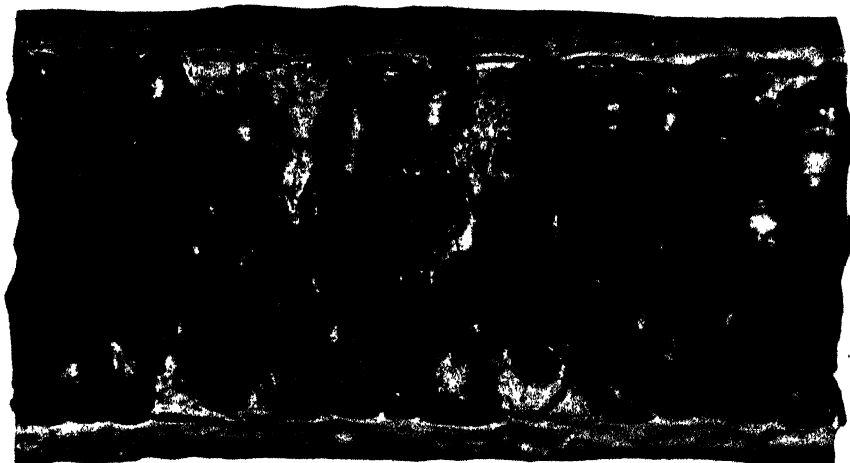


FIG. 3. WOOL-HAIR, SHOWING ALMOST THE WHOLE OF THE FIBRE OCCUPIED BY MEDULLA. $\times 400$.



FIG. 4. WOOL-HAIR, SHOWING WELL-DEVELOPED MEDULLA AND SCALES CLOSELY PRESSED ON TO THE CORTEX $\times 400$.



FIG. 5. WOOL-HAIR, SHOWING MEDULLA AND FAIR SCALE-DEVELOPMENT. $\times 400$.



FIG 6. TRUE WOOL-FIBRE, SHOWING POINTED SCALES. $\times 400$.

[Microphotos by Biological Laboratory.]

in comparative absence of kemps New Zealand wools compare more than favourably with the average British wools. The term "kempy" wool is often applied to coarse, fairly straight britch-wool, but such wool does not consist of kemps, but is generally thick medullated wool-hair.

Medullated wool-fibres: These consist of fibres of equal length to those of the ordinary fibres of the fleece; at times they may be longer than the surrounding wool-fibres. In certain instances they are coarser than the rest of the fibres, but in many cases their count or thickness may be less than that of the ordinary wool-fibres. They contain a

medulla or central strand, which may vary considerably in thickness. The cortical tissue is generally poorly developed, and this results in almost complete absence of any elasticity. The scale-structure is often quite well developed, particularly if the sheep possessing such medullated wool-fibres have been kept well fed and are not exposed to hard conditions. When fairly straight and possessing no curl or crimp they can be readily picked out by hand, but when possessing a decided crimp, which they frequently do, microscopic examination is often necessary to decide whether they are true wool or not.

Non-medullated wool-fibres: These contain no central strand or medulla, the whole of the tissue, with the exception of the scales, consisting of a compact mass of fusiform cells of very considerable elasticity. By possessing no medulla they can be looked upon as true wool, and represent the type of fibre it should be the aim of all wool-growers to produce. During my investigation it became abundantly clear that it is the presence of medullated fibres in excessive amounts that has caused the complaints that have been levelled against some of our Romney and Romney-cross wools, although such are not the only New Zealand wools in which medullated fibres are conspicuous.



FIG. 7. LONGITUDINAL SECTION OF WOOL-HAIR, SHOWING STRUCTURE OF THE MEDULLA. $\times 400$.

[Microphoto by Biological Laboratory.]

SIGNIFICANCE OF MEDULLATED FIBRES.

Although without doubt the main source of complaint against New Zealand Romney and Romney-cross wools is based on the presence of considerable proportions of medullated fibres throughout the fleeces—or, in other words, the presence of what may be termed wool-hairs—such wools are no worse in this respect than similar wools elsewhere. For instance, the proportion of wool-hairs in a number of British-grown wools examined has been shown to be in many cases very high. It is, however, being generally recognized that such wool is not suitable for the production of really high-grade clothing. As New Zealand wools of all classes have hitherto held a very enviable reputation on the world markets, it will be a sound policy for New Zealand wool-growers to be on their guard against allowing any increase in the amount of hairy wool produced in our clip.

A feature with regard to wool-hairs is the fact that their presence tends to cause dryness of the fleece, leading to the production of dry, wasty, and brittle tips. Whether this is due to the amount of yolk



FIG. 8. FIBRES FROM ROMNEY FLEECE CONTAINING WELL-DEVELOPED MEDULLA.
× 120.

Such fibres are really hair, and may be termed wool-hairs.

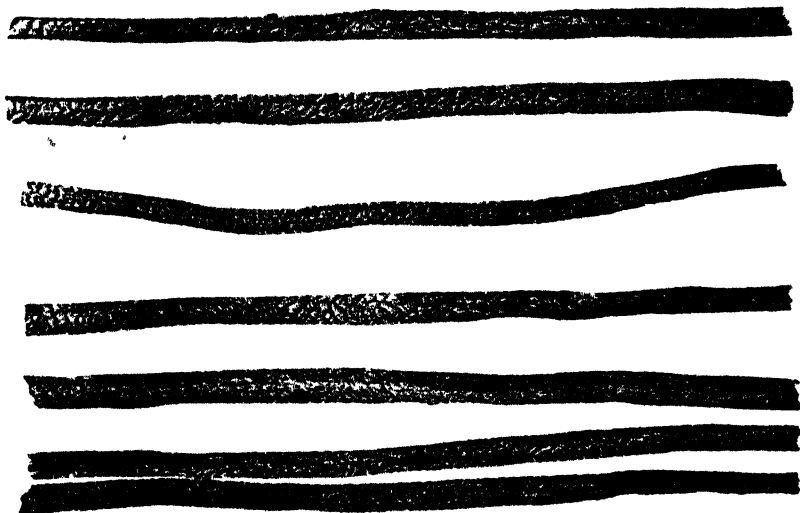


FIG. 9. GOOD TYPICAL ROMNEY WOOL, SHOWING COMPLETE ABSENCE OF ANY
MEDULLA. × 120.

[Microphotos by Biological Laboratory.]

produced being less, or whether a greater amount of yolk is necessary to lubricate medullated fibres properly, is not known. The fact, however, remains that hairy wools tend to dry out excessively, and when this takes place the scaling of the medullated fibres becomes more like those on true hair than on true wool. As has been mentioned, the

presence of wool-hairs is in New Zealand not confined to any one breed, but certainly occurs in higher proportions in Romneys and Lincolns than in any others. In fine wool such as Merino they are rare, except on the lower portions of the britch, but in Corriedales they may at times be found scattered throughout the fleece, indicating perhaps their Leicester or Lincoln origin, both these breeds being extremely prone to the development of medullated fibres.

During an examination of many Romneys, Lincolns, and English and Border Leicesters great variation in the amount and type of medullated fibres was found. In general, even on the best of woolled sheep a small proportion of medullated fibres will be found on the britch, but the rest of the fleece may consist of true wool. In other cases a large proportion of medullated fibres is present on all portions of the fleeces, and many Romneys and Lincolns may contain no true wool, or what I have termed true wool, every fibre of the fleece being of the medullated type. The amount of medulla and its thickness vary very much—from almost the whole of the fibre consisting of medulla to only scattered portions of medulla being present in isolated patches through the centre of the fibre. The main objections to medullated fibres are four in number: they produce a harsh-handling fleece; they produce a dry, light fleece; they produce a non-elastic fibre; and they give a dull appearance to the fleece. This last feature is very characteristic, and is due to the fact that air in a very finely divided state occurs in the cells of the medulla, and this does not allow light to pass through the fibre, but reflects it from its surface.

It is essential that all sheep-breeders, particularly those with Romneys and Lincolns, should make every endeavour to breed out the tendency of their flocks to produce medullated fibres. In other words, they should aim at producing true wool rather than hair masquerading under the title of wool. The use of rams showing any sign of hair-like fibres in the shoulder-wool should be avoided. So far as the britch-wool is concerned, a small proportion of hair-fibres is always likely to be found. It is the presence of medullated fibres in the shoulder-wool that should be specially guarded against, as rams possessing this defect undoubtedly are prone to transmit medullated fibres rather than true wool to their offspring.

Contagious Mammitis.—While this disease gave a considerable amount of trouble and was no doubt the cause of great financial loss (states the Director of the Live-stock Division in his annual report for 1923-24), it did not appear to be quite as prevalent as during the two previous seasons, this being particularly marked in the Canterbury-West Coast and the Otago-Southland Districts, and an improvement was also noticeable in the Wellington District. Observations have again shown the disease to be more troublesome where milking-machines are in use, and want of ordinary care in regard to cleanliness and sterilization of machine-cups, &c., and want of constant care in the daily hand examination of the udders, are a very important factor in the spread of this disease throughout a herd. During the year 794 samples of milk were received at the Veterinary Laboratory, Wallaceville, from cases of suspected mammitis. Of these, 343, or 43 per cent., were found on examination to be from cases of contagious mammitis, 226 were of the non-contagious type, and the remaining 225 were normal.

VARIATIONS IN THE PERCENTAGE OF BUTTER-FAT IN MILK.

II. DAILY VARIATIONS.

W. N. PATON, Dairy Division, Wellington.

THE majority of dairy-farmers know that cows vary in test from milking to milking and from day to day, and that these variations, although small on the average, may at times be practically nil, while at others they may be very considerable; but it is doubtful if the causes of these changes and their significance are so well known. Tests quite often vary extremely, and seemingly for no apparent reason, but experience teaches that there is practically always a reason if the full facts are carefully studied, and that, after all, the ways of the cow are not strange. As one writer aptly puts it, "She does and she doesn't, and then she does neither, only because we are not keen observers of the reasons for the changes." Of course, the reasons for small or normal variations are not so readily apparent as in the case of extreme variations, but from a careful study of the latter much may be learned in regard to the former.

The causes of the fluctuations in the quality of milk from milking to milking and from day to day may be grouped under two headings—natural and unnatural. The former include causes due to the state of health and to the period of menstruation of a cow, while the latter include causes due to the length of the interval between milkings, weather, exercise, treatment, food, and general conditions. As practically all causes are controllable, it is possible for the dairy-farmer to remove those which give detrimental effects. This can be done only by systematic and regular attention to details of care, feeding, and treatment.

As the result of numerous investigations, the factors influencing the daily test have been fairly definitely established. Still it has to be admitted that knowledge is scant in regard to the physiological reasons for the fluctuations, and that little progress can be expected until more is known about the functioning of the glands of the cow's udder, and the manner in which they manufacture the various components of milk and from what sources. As authorities differ on various points, this article is more an attempt to set out briefly what is known on the subject, and review it as comprehensively as knowledge will permit, than to supply definite reasons on all points of its many and varied phases.

MORNING'S AND EVENING'S MILK.

Evening's milk, as a rule, tests higher than morning's milk, even if the intervals between the milkings are equal. Although it has not been definitely settled why this is the case, most authorities put it down to the fact that during the daytime there is a greater metabolic activity than during the night-time, and that more fat is then in circulation in the blood. It is also attributed by some as being a provision of nature in order that the calf may be better able

to withstand the colder temperatures during the night. It would be interesting to obtain data in order to ascertain if this difference in quality of milk is less at later periods than just after calving. In all probability this should be the case if the foregoing statement is true, for the need of richer food for the calf at night would naturally be less as it grew stronger. In general, a rising temperature lowers the test and a falling temperature raises it, but only by small amounts, and this may have some bearing on the change in quality of milk for milkings at different times of the day. However, the main reason for the difference in the quality of morning's and evening's milk is due to the length of the interval between milkings, since, as a rule, cows are milked later in the morning than in the evening, and the test is generally higher for the shorter interval. By making the milkings earlier in the morning than in the evening it is possible to have the morning's milk test higher than the evening's milk.

LENGTH OF INTERVAL BETWEEN MILKINGS.

It has been shown that a cow tests higher for the shorter interval than for the longer interval, and as cows, as a rule, are milked later in the morning than in the evening, this partly accounts for the morning's milk being poorer in butterfat than the evening's milk. The truth of this seems to have been definitely established, seeing that the greater the difference in the length of the intervals between milkings the greater is the difference in tests for those milkings. Thus it might be expected that with equal intervals and milk-yields the tests should be equal. Speaking generally, however, this has not been found to be the case, although the difference has been small in most instances. The probable effect of the temperature at the time of the day of the milkings must not be overlooked, however. It seems from this that until the effect of the one is definitely settled that of the other will remain indefinite: Some say that a cow used to being milked at unequal intervals fails to give equal tests for equal intervals because of having long accustomed herself to the other conditions.

FIRST AND LAST MILK.

As the milking proceeds, the richness of the milk increases uniformly portion by portion, commencing with a low and ending with a high butterfat-testing product. The reason for the "fore-milk" testing lower than the "strippings" seems to have given considerable trouble, since so many different theories have been advanced by way of explanation of this difference.

The chief theories put forward are as follow:—

(1.) The butterfat-globules in milk vary in size, the foremilk containing the greater percentage of small globules, and the strippings containing the greater percentage of large globules. The explanation is that the larger globules are held back mechanically in the very fine passage-ways of the udder, the network of extremely fine tissues acting as an obstacle to their ready release.

(2.) The pressure due to the quantity of milk in the udder retards the secretion of butterfat, and as the pressure is released during milking the rate of secretion of butterfat is correspondingly increased.

(3.) Butterfat, being the lightest constituent of milk, rises to the surface on standing, and this is believed to take place to some extent in the udder of the cow, with the result that the last milk is the richest. This is given only as part explanation.

(4.) The butterfat is secreted and held captive in certain cells in the glands of the cow's udder, and as these become more and more distended with butterfat they rupture. The number of cells rupturing per unit of time increases during milking, and therefore the last milk is the richest.

It will be readily apparent that opinions differ considerably, and a brief discussion of their respective merits may be of advantage—taking the foregoing theories seriatim.

(1.) As the size of the fat-globules is so minute, it is thought unlikely that they could be held back mechanically to any extent, especially as the products of secretion normally move down through the upper tissues of the udder to the cisterns situated just above the teats. Owing to the viscous nature of butterfat, the globules may have power to adhere to the tissues and so retard their downward progress, but this will hardly account for the fact that it is chiefly large globules which have been found in the upper tissues of the udder on *post mortem* examination immediately after milking. A point worth noting in this connection is that the average size of the fat-globules increases uniformly during milking.

(2.) This theory is rather difficult to establish by means of experiment, but, if it held good, it would mean that immediately secretion had recommenced after complete milking had been effected the rate of secretion of butterfat should be greater than at any other time, as the pressure in the udder would then be at its minimum. The rate of secretion of milk is believed to somewhat depend on the pressure of milk in the udder, and it is reasonable that this should apply to each component of milk as well.

(3.) The third theory is based on the fact that the range of variation in quality between the first and last milk is greater where a cow has stood quietly for some time before milking than where a cow was taken direct from pasture and milked. Also, if a cow is allowed to stand for an hour or so, and the udder thoroughly massaged before milking, the range of variation in quality from first to last milk is found to be less than in either of the other two cases. This seems fairly definite, and is put forward as being only one of the probable causes.

(4.) This theory was based on the fact of finding by microscopic examination more ruptured butterfat-secreting cells in the glands of the udder when it was cut open immediately after complete milking than after partial milking. The theory has much to commend it, and at the same time should be considered in conjunction with the second theory, since the rupturing of the highly distended fat-cells would no doubt be greatly facilitated by the reduction of internal pressure in the udder.

NUMBER OF MILKINGS PER DAY.

The difference in quality of milk from milking to milking is usually more marked with three milkings than with two, and with four than with three. This is probably accounted for partly by the difference

in the length of intervals, and partly by the effect of change of temperature during the day. It is claimed that the average daily test is raised slightly for an increase in the number of milkings. Milk and butterfat production may be somewhat increased by this means, and it is considered possible that the test may also be raised slightly, if only because of the second and fourth theories as presented under the heading of "First and last milk." It is estimated, however, that the increase would not be very permanent, and would merely be noticeable for a short time immediately following the change.

MILK FROM DIFFERENT QUARTERS.

Two or three investigators have stated that milk varies in quality and quantity for the different quarters of a cow's udder, and that the milk from the left fore quarter usually tests lowest, while that of the right back quarter tests highest. Others in commenting on this statement point out that the order of milking the quarters may have considerable bearing on the question, and in view of the facts it is highly probable that this is the sole reason for the variations discovered, and that the quality does not appreciably differ.

SKILL AND SPEED OF MILKING.

Skill and speed of milking also have influences on the test, inasmuch as it has been proved that the longer a person takes to milk the lower the test may vary from normal. Not only this, but a skilful and fast milker, as is well known, will obtain more milk; and it is probably because of this fact that he also obtains a richer milk, owing to the larger quantity of last milk obtained. With a slow milker the cow does not respond so readily, and does not give down all the milk possible, and thus, owing to the small amount of true strippings obtained, the milk is poorer than normal.

PARTIAL OR INCOMPLETE MILKING.

This is practically the same thing as dealt with in the preceding paragraph, only that in that case incomplete milking is done unwillingly, while in this it may be done with intent. When milk is left in the udder as the result of incomplete milking, will this affect the test for subsequent milkings, and in what way? As a rule, the test for the incomplete milking is lowered, and those for the next milking or two are raised, but not by very appreciable amounts, and without absolute surety. The case of what is known as a cow "holding" her milk may also be considered. According to most writers on the subject, this does not take place, as it is contended that a cow is unable to wilfully hold her milk. All milkers will have noticed that there comes a pause in the flow of milk during milking, and that this usually occurs before the middle of the milking, and that by working at the teats the flow comes again. This secondary milk is said to be "made while one waits," or, in other words, the cow secretes this extra amount by a "reflex" action, doubtless because of nature's provision to satisfy the calf should the supply of milk in the udder become fully exhausted. If a cow is upset or excited, or slowly milked, she does not secrete so much of the secondary milk, for the reason that the nervous system unconsciously controlling the process does not come

into action so readily as is the case when conditions are favourable. Thus it is not a case of the cow refusing to give down or prevent the escape of any milk already in the udder. Some say this "secondary" milk, as it may be called, amounts to nearly two-thirds of the total quantity given at a milking, while others consider it less than this amount, and others, again, discredit it entirely. The art of milking is in obtaining as much of this secondary milk as possible; the "reflex" action soon ceases if the necessary stimulus is not maintained which excites the nerves that bring it into play. If this milk is not obtained, or only partly obtained, the test, as a rule, is lowered as in the previously mentioned cases.

METHOD OF MILKING.

It is contended by a few investigators that the test can be raised in milking a cow by taking diagonal pairs of teats instead of the conventional method of taking front and back pairs. Then, again, it might be suggested that side pairs could be taken, especially as each side pair is connected with a separate mammary gland. Besides this, it is said that by having two milkers, and milking all quarters simultaneously, both quality and quantity of milk are increased. This statement is not well authenticated, as little evidence has been brought to light in regard to the matter, although it is considered quite likely that the yield of milk would be slightly increased, especially since milking two quarters at a time gives better results than one quarter at a time.

FEED.

Many farmers have endeavoured, without or with little success, to raise the test by the use of certain kinds of feed. It can be safely stated that there is no feed which will of itself appreciably raise the test. By the use of certain feeds it is possible to raise the test by small amounts, but such increases are usually only temporary, and soon decrease again. Provided a cow is well fed and receives a good variety of palatable food which supplies the essentials, she will return as much butterfat by this means as by any other, and with less trouble to the feeder. If a cow is starved the milk decreases, and the test usually rises slightly, but only for a short time, for she then draws on the fat of her body to help keep up the quality of her milk, and as these stores become depleted the milk gradually becomes poorer in quality and falls below normal.

WATER-SUPPLY.

Shortage of drinking-water decreases the milk-flow and usually increases the test slightly. Very cold water is also a cause of decrease in the quantity of milk, but its effect on the test is practically nil. The effect of unclean water would be to upset a cow, with a consequent reduction in her milk-yield, and in all probability a fall in test as well.

EXERCISE AND TREATMENT.

Exercise, provided it is not excessive, has a stimulating effect on cattle—much as it has on human beings—and the appetite benefits accordingly. In this country cows are not housed for any period of the year, and therefore receive plenty of exercise and fresh air, and this is probably the reason for the fact that the average tests

for the various breeds in New Zealand are higher than those for the same breeds in most other countries. If the exercise is fairly strenuous it results in a reduction of the yield of milk, and is accompanied in most instances with a rise in the test, but should the exercise be very severe both may be detrimentally affected.

Ill treatment has a similar effect, and, if persisted in, may cause permanent lowering if not absolute cessation of production for the lactation period. However, due no doubt to the adaptability of the cow, the test always tends to return to normal after being affected by such means.

HEALTH AND CONDITION.

The state of health or condition of a cow has considerable influence on the amount and richness of her milk. Generally when a cow is slightly ill or slightly injured the milk-yield is reduced, with an accompanying rise in the test; but should illness or injury be of a severe nature the cow may go completely dry, and in any case will drop very low in yield. The test in such cases is erratic, and may be up or down, or both alternately, but is lowered as a rule. The condition of a cow influences the test, but as the animal loses or gains condition gradually the effect on the daily tests is negligible.

PERIOD OF MENSTRUATION.

As a rule, the milk-yield is slightly lowered when a cow is in "season," although some cows show little difference. When the yield is lowered the test generally shows a rise, but provided the yield is not appreciably influenced the test remains practically normal. In some cases, however, the test may vary up or down considerably, and no definite explanation can be given. It is usually in such cases that the milk-yield shows considerable variation also, being perhaps down one milking and up the next.

WEATHER.

As a rule, very rough and bleak weather reduces the milk-flow and test as well, but where cows are well protected the effects are very slight. Fine, cold weather, when the air is clear and fresh, tends to raise the test, while hot or warm muggy weather tends to lower it. The reason for this is that in the former case the appetite is stimulated, with a resulting larger amount of food consumed, while in the latter case the effect is just the opposite. In fact, there seems good reason to believe that a cow feels the effects of the weather much as do human beings. A point worth mentioning in regard to influence of weather on the test is that the effect is often belated, and does not fully manifest itself until, perhaps, the second milking after the change, or even later.

GENERAL CONDITIONS.

Under this heading are included such changes that may tend to upset a cow, such as change of field, disturbance by dogs, presence of strangers, excitement, change of milkers, and so on. The effect of these conditions depends on how much the cow is upset; as a rule, they have a more noticeable effect on the milk-yield than on the

test, unless, of course, the period of distress is longer or severer than usual for such causes. Cows will often fret considerably when separated from others or from their usual surroundings, and this results in a reduction of milk-production and usually an increase in the test. The case of a cow being separated from her calf after calving is of little importance, since no reliable test can be obtained from her milk until about the fourth day, and by that time she will be more settled.

CONCLUSIONS.

From a careful study of the variations of daily tests and of their causes it appears that there are three main rules which govern these fluctuations, but it must be remembered that they are not invariable, and that they merely represent the general tendencies. They are briefly as follows:—

(1.) The test varies inversely with the milk-yield, provided that the variations in the milk-yield are not of an extreme nature, in which case no definite rule can be given.

(2.) Whenever the test is influenced by any means it soon tends back to normal, and usually in doing so swings slightly past normal in the other direction before returning to normal.

(3.) In the case of a cow receiving good feeding and attention generally the test cannot be permanently raised by any appreciable amount by the use of special feeds.

(To be continued.)

NOTES ON THE OCCURRENCE OF CERTAIN EXOTIC PLANTS IN NEW ZEALAND.

H. H. ALLAN, Feilding.

INTEREST in the exotic plants occurring in New Zealand has been quickened by the publication in recent years of two important books—"The Naturalization of Animals and Plants in New Zealand," by G. M. Thomson, and "Tutira: The Story of a New Zealand Sheep-station," by H. Guthrie-Smith. The former contains a careful account of all the exotic species recorded up to the date of its publication, with valuable historical notes; the latter is a truly unique work, which belongs to that rare class of books that are at once science and literature. No student of natural science on its ecological side can afford to neglect "Tutira."

But there still remains much misunderstanding of the true status of naturalized plants in New Zealand, notwithstanding that Dr. L. Cockayne, in several of his writings, has clearly stated the true position. One may quote from his great work, "The Vegetation of New Zealand," the following: "*Wherever any part of New Zealand is in its primitive condition and uninterfered with by man or the animals he has introduced, none of the exotics have gained a foothold, their great powers of dissemination notwithstanding, although the virgin*

area may be pierced in all directions by ground occupied by man where there are introduced species in plenty. On the other hand, where man has separately or collectively brought into play fire, draining, cultivation, and introduced domestic or feral animals, he has created a new environment where indigenous and introduced species, if the latter be present, alike go to the wall and new associations arise, or are purposely produced, made up, it may be, purely of exotics, though frequently of such and native plants. Thus there are two distinct areas, the one dominated by primitive New Zealand conditions and the other by such as approximate to those of Europe, while between these extremes is a gradual series of intermediates."

Now, although long lists of so-called "naturalized" plants may be and have been misleading, it remains true that it is important to record the occurrence of new exotic species as such becomes known. Especially is this true from the farmers' point of view. Plants that are a menace to pastures or arable land, or are poisonous to stock (only recently a case came under my notice of a farmer who had fed off a luxuriant growth of hemlock with dire results!) or harmful in other ways, may become established because no special notice was taken of their first appearance, nor inquiries made of their possible significance. The authorities are keen to prevent the entry of alien weeds, but their efforts should be supplemented by those of all interested in the welfare of the land. Many a serious weed has crept in unnoticed, established itself in an obscure corner, advanced stealthily through the land, and suddenly the farmer finds that a new enemy is in arms against him. The Noxious Weeds Act may be read over the delinquent, but the time for most effectively dealing with the pest has passed. Here our schools could help valuably, both by training pupils in the art of keeping their eyes open, and by acting as centres to which farmers could send specimens of suspicious plants for forwarding to those who could supply the necessary information about them.

A striking case that came under my notice is that of the establishment of *Hieracium praealtum*, which in Canada and the United States goes by the name of "king-devil," and thoroughly earns its title. Hidden away in the recesses of stream-gorges at Mount Peel and the Orari Gorge, Canterbury, it flourishes in profusion, and thence has spread along the Rangitata and Orari Rivers on to the upper pasture-lands and roadsides of the plains. It has also been found to the north of the Ashburton River. The plant bears long, blue-green, rather hairy leaves in rosettes, and sends up well-branching heads of dandelion-like flowers which set quantities of seed easily spread by the wind. In addition it sends out from the base long arching runners which bend down and root in the soil, and, growing vigorously, produce strong new rosettes. Finally, a patch of considerable size may be produced. So well established is this species that the chances are remote of its being eradicated, and unless close watch is kept it may become a pest of serious moment. Canadian experience shows that the plant is refused by stock, spreads easily, and, once established, is very aggressive and difficult to get rid of.

Hieracium Pilosella (mouse-eared hawkweed) was observed to be well established in certain pastures near the Hinds River, Canterbury

Plains, but in its present state could be eradicated if seriously tackled. This species is a low-growing plant, its short runners producing a dense mat, to the exclusion of other vegetation. The flowers are like pale yellow dandelions, on single stalks, and the leaves blue-green and very hairy. As it flowers abundantly its spread is only a matter of time. This is a case where timely action will prevent a great deal of subsequent bother. In Canada it is considered even a worse pest than the king-devil, taking absolute possession of entire fields.

Hieracium aurantiacum (orange hawkweed) has been recorded as occurring at the Waiau, North Canterbury. Several small patches were noted in a pasture near Ashburton, but at my suggestion were cultivated out, and did not return. It is of similar growth to the king-devil, and has quite pretty orange-coloured flowers in abundance. "If possible, the sentiment of an entire neighbourhood should be aroused against orange hawkweed, for, with a plant of this quality, the careful farmer is largely at the mercy of any slovenly cultivator who chooses to be regardless of communal welfare," says Ada Georgia ("A Manual of Weeds"). It is said that small patches in pastures may be killed out by covering them with salt at the rate of 18 lb. to the square rod.

Cerastium arvense (field mouse-ear chickweed) is well established in certain pastures at Ashburton. While not so virulent as the previously mentioned plants, it is an undesirable pasture-weed, despite its rather pretty appearance when covered with small, graceful, white, starry blossoms. It is not difficult to get under control in arable land.

Crepis biennis (rough hawksbeard) is a common plant in Ashburton grassland. It is similar in appearance and characteristics to the widespread and abundant smooth hawksbeard (*Crepis capillaris*), but is large and covered with rough hairs. The two species hybridize, and therefore intermediates are not uncommon. It may here be mentioned that the common New Zealand piripiri (*Acaena Sanguisorbæ* vars.) hybridizes with the Australian sheep's burr (*Acaena ovina*) where the two occur together.

Lamium amplexicaule (henbit deadnettle), recorded by Armstrong for Canterbury in 1879, is a common weed in rich garden soil at Ashburton.

Other species that may be mentioned are: *Ranunculus Lingua* (great spearwort), which is naturalized in certain water-races near Longbeach; *Papaver hybridum* (field-poppy), occurring in arable land, Ashburton; *Trifolium striatum* (striated clover), closely related to the more common scabrid clover (*Trifolium scabrum*), infrequent as a roadside plant, Ashburton; *Caucalis daucoides* (burr parsley), a weed of waste places at Ashburton; *Salvia Verbenaca* (wild sage), recorded for Auckland, occurs sparingly in dry pastures at Kakariki, near Feilding; *Valerianella Locusta* (lamb's lettuce), recorded as *V. olitoria* for several places in the North Island (a specimen of this from near Akaroa was given to me by Professor Wall, of Canterbury College); *Veronica scutellata* (a water-speedwell) occurs in certain ponds near Feilding, and another species, related to *Veronica anagallis-aquatica*, occurs in ponds along the Waitaki River, near Glenavy; and *Juncus*

acutus (a tussock-forming rush), which is well established in sand-hollows at Foxton. For the identification of this last species I am indebted to Mr. D. Petrie.

Harbours are a favourite place for aliens to secure a foothold, and should be closely watched so that dangerous species can be eradicated when first observed. The classical example of these "ballast-plants" for New Zealand is that described by Kirk in the *Transactions of the New Zealand Institute* for 1895 (vol. 28). In the year 1912 I observed the following species at Oamaru Harbour: *Scleropoa rigida*, a quaint grass that has been recorded from a number of places, but does not increase; *Asphodelus fistulosus* (onion-weed), a bulbous liliaceous plant, said to be fairly common in the northern parts of the North Island, that is considered a serious pasture-weed in Victoria, and is well established at Oamaru Harbour; *Emex australis* (spiny dock), which died out in a few seasons; *Argemone mexicana* (Mexican poppy), (this made the harbour gay for several seasons, but at my suggestion steps were taken to eradicate it, I understand successfully); *Diplotaxis tenuifolia* (one of the rockets), related to *D. muralis*, also naturalized, which was plentiful and thoroughly at home at the harbour.

The vagaries of certain species afford an interesting study. Some, having gained a foothold, seem unable to spread farther; others spread rapidly, and then seem to fade away; others, again, spread steadily. *Eruca sativa* (a cruciferous weed), reported as occurring on the Great Barrier Island by Kirk, remained rare till the recent increase in lucerne-growing, when it became familiar. It has not yet, however, earned the title of a naturalized plant elsewhere than in the place of its first discovery. *Matricaria suaveolens* (= *M. discoidea*, rayless mayweed), since its first record in 1882 in Auckland, has spread steadily southward, and is now a familiar roadside weed almost throughout the North Island. *Lactuca muralis* (wall-lettuce), common in Marlborough in 1906, has spread rapidly of recent years in damaged forest in the upper Motueka and Motupiko valleys. *Ottelia ovalifolia* (a pond "lily"), first observed in Auckland in 1897, is now common in ponds as far south as Feilding at least. *Alisma plantago-aquatica* (water-plantain), recorded in Hawke's Bay in 1892, and near Marton in 1906, has now crossed the Rangitikei River from the latter place. *Polygonum Hydropiper*, apparently only recorded for the East Cape district, is a most abundant plant on river-beds and water-races at Ashburton, and is also abundant in similar situations near Feilding. On the other hand, *Scandix Pecten-Veneris* (shepherd's needle)—to take one example of a weed decreasing in virulence—once very abundant near Ashburton, is now exceedingly rare in that neighbourhood. The whole subject of the ups-and-downs of exotic plants is of considerable interest, and not unimportant, but is beyond the scope of the present article, the main object of which is to suggest the advisability of prompt record of the appearance of new plants in a district.

My identifications of all the species here mentioned, except *Juncus acutus*, were concurred with by the late Mr. Cheeseman, who took a deep interest in the question of the naturalization of exotics, and was ever ready to assist the student with his wide knowledge of these plants.

LOSS IN WEIGHT OF STORED APPLES.

OUTLINE OF FLESH-COLLAPSE EXPERIMENTS IN NELSON DISTRICT, SEASON 1924.*

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EXPERIMENTATION with cold-storage conditions for determining their possible relation to the physiological disease of the apple known as flesh-collapse is scarcely practical even in the smallest commercial chambers. Two to five thousand cases is a large amount of fruit to have at stake, and there is considerable risk in subjecting such a quantity to a set of conditions widely divergent from those in current practice. Under the circumstances, however, this was required to be done. The immediate losses in cool store and elsewhere had to be checked while the cause and remedy of the disease were being sought. These requirements demanded, firstly, some alteration and improvement in the general storage programmes in vogue; secondly, increased vigilance, so that excessive losses might be avoided by timely unloading if necessary; and, thirdly, the institution of experiments with cool-storage conditions on a large scale in commercial chambers—for there is no other accommodation. The responsibility of such a procedure was duly represented to all concerned. The growers, however, responded by volunteering thousands of cases of apples for treatment under certain new storage conditions that had promise of success, and the local cool-store companies willingly co-operated by offering the requisite space and facilities for extensive experimentation.

NATURE OF THE 1924 EXPERIMENTS.

Under these circumstances about seven thousand cases of apples mainly Sturmers—were finally placed under experimental conditions. These were distributed among four separate cool-storage companies. Two of these companies received only a few cases each; the other two took the bulk, for one of them had allotted a five-thousand-case and the other a two-thousand-case chamber especially for experimental purposes. The results obtained from these two experimental chambers are being used from time to time as a guide to the general storage programme for the non-experimental chambers, which are of various sizes and have a total capacity of over sixty thousand cases.

Of the seven thousand cases thus placed under experimental conditions the bulk was picked—cases being marked with the date of picking—by twenty different growers in the ordinary commercial way, but more or less at a time that was freely advertised as the best for cool-storage purposes by the Department's Horticulturist, Mr. W. C. Hyde, and the writer. This resulted in the delivery of a considerable proportion of the Sturmers, and even of other varieties, at an earlier stage of maturity than that chosen in 1923. It is believed that this in itself accounts to some extent for the much better results obtained

* An account of previous work in this investigation was published in the *Journal* for July, 1923, page 32.

this season. "Packing-out" returns are being supplied by these twenty growers as the fruit is sent to market.

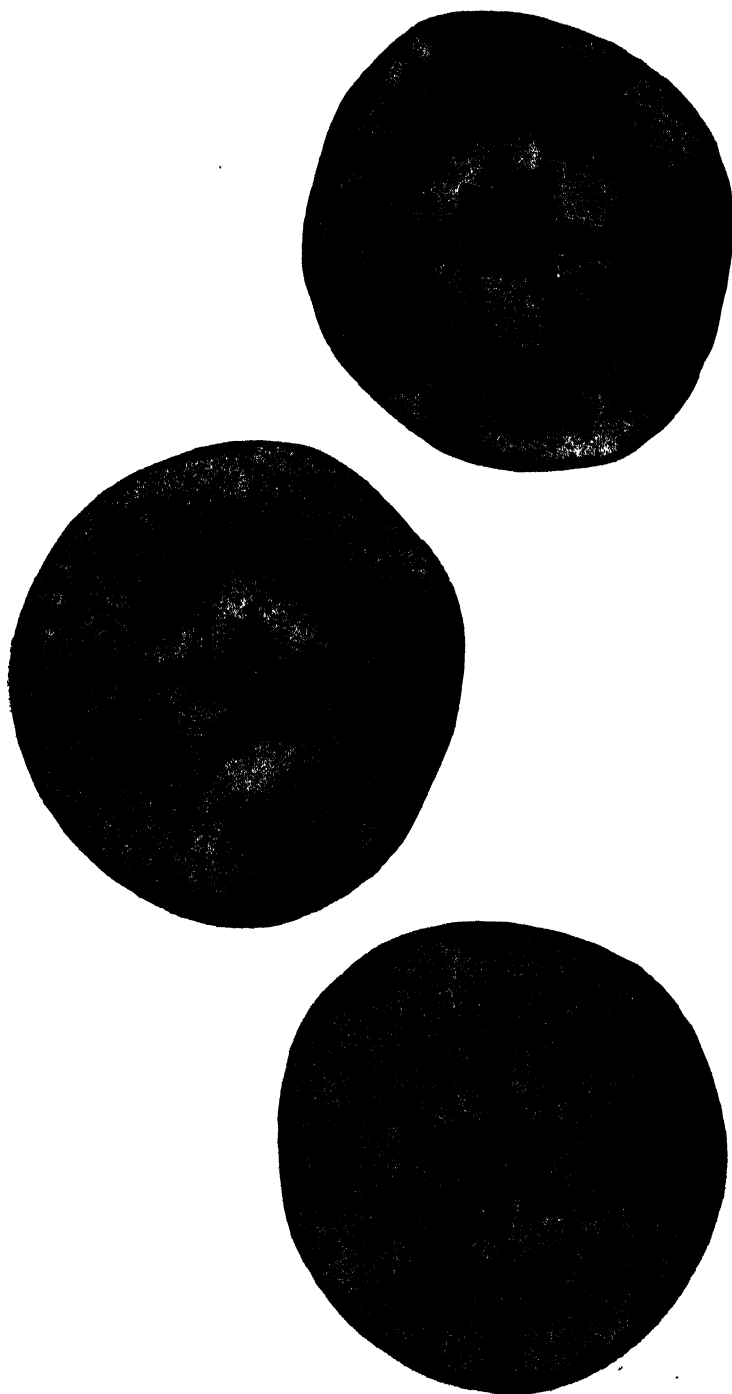
The remainder of the seven thousand cases—230 cases in all—were picked by the Horticulturist and the writer from two orchards the fruit of which in previous years had suffered in cool store up to 40 per cent. and more from flesh-collapse. One of these orchards is on rich alluvial land, and the other on relatively poor hill country. The fruit from one went into the five-thousand-case experimental chamber, while that from the other went into the two-thousand-case chamber.

The owners of the two orchards each set aside a plot of Sturmer trees for these experiments. From each of these plots six "first picks" were made, a fresh set of trees being used for each pick and the most advanced fruits being selected each time. (See explanation (d) at end of article.) Each of these six first picks provided five cases of a bushel each for an experimental chamber, and five for a non-experimental—that is, an ordinary commercially run chamber-control. The first, third, and fifth of these first picks also provided five cases for storage in the packing-room of a cool store at natural temperatures and humidities; and also for one case, the fruit of which weighed exactly 30 lb., for an experimental chamber; one similarly for a non-experimental chamber-control; and one likewise for a packing-room at natural temperatures and humidities. These were for the loss-in-weight experiments. (See explanation (c).)

The first of the first picks was made well before any other growers had picked Sturmers for storage. The fruit was by no means full-sized, and was, of course, immature—2nd March for the two-thousand-case chamber, and 5th March for the five-thousand-case experimental chamber. The last of the first picks was made after all growers had stripped their trees. The fruit was dropping from the trees, and was, of course, overmature—29th May for the five-thousand, and 2nd June for the two-thousand-case experimental chamber. The four intermediate picks were made at intervals.

In addition to this, two "second picks" (see explanation (e)) were made from the trees off which first picks had already been taken, in each case five cases being provided for an experimental chamber and five for the non-experimental chamber.

Thus it will be seen that arrangements were made to demonstrate in two experimental chambers belonging to two separate cool stores the best stage of maturity at which to make the first and second picks of Sturmers for the peculiar storage conditions it was decided to provide. The five cases taken at each pick provided for five examinations of the internal and external conditions of the apples from time to time, this being part of the vigilance programme. The fruit in the packing-room was to enable a comparison to be made of the relative advantages in delaying the advancement of maturity and in arresting the development of rots, shrivel (see explanation (b)), flesh-collapse, &c., under the experimental conditions as against those of unrefrigerated storage. The fruit in the non-experimental chamber would, it was hoped, show the relative advantages in similar respects of the customary methods of each cool store as against the new method in the experimental chambers. It will be seen later that these hopes have not been fully realized. Finally, the nine lots of accurately weighed fruit at each



MEDIAN TRANSVERSE SECTIONS OF EPPS' SEEDLING APPLES FROM COOL STORE.

Showing (1) a healthy apple; (2) an apple slightly flesh-collapsed, notably from its ten primary vascular bundles outward; (3) an apple badly flesh-collapsed in the cortex, but not in the pith or centre.

[Photo by H. Drake, Biological Laboratory.]

store would, by subsequent periodical weighings, enable the progressive loss in weight in the packing-rooms, the experimental chambers, and the non-experimental chambers to be determined. From results thus secured in the experimental chambers it would be possible to estimate what was the average loss in weight for the whole of the fruit in these chambers (seven thousand cases), and to accelerate or retard this loss in weight as one thought fit. Again, seeing that the loss in weight would certainly be greater in the packing-sheds than in the experimental chambers, and greater in the experimental chambers than in the non-experimental chambers, it would be possible to note any detrimental effects arising from progressive losses in weight among the few cases in the packing-room long before such losses had been effected amongst the seven thousand cases in the experimental chambers. Similarly, any detrimental effects would manifest themselves among the seven thousand in the experimental chambers before they were allowed to show themselves amongst the sixty thousand cases in all the remaining non-experimental chambers.

Experimentation under the circumstances has not been altogether satisfactory from a scientific standpoint. It has been difficult and sometimes impossible to secure exactly the desired conditions, nor has it been possible to attain that precision which is so essential for proof in experimental work. It is believed, however, that when the experiments are completed they will at least direct attention to a fundamental principle in cool storage which appears to have been hitherto overlooked—a principle that may prove to be of value in cool storage both on land and sea, and one that will amply repay further investigation on more exact lines. The experiments had another three months to run, dating from the last examination at the end of August last, but there was no commercial damage to Sturmers in the experimental chambers at that time, whereas last year up to 50 per cent. of deterioration from flesh-collapse had occurred before that date. There is another important point: The apples from the experimental and some of the non-experimental chambers are in a most desirable condition for transport—that is, slightly wilted (see explanation (a)), and are arriving on the market with remarkable freedom from bruising and case-marks. This is due directly to the conditions under which they have been stored.

It remains now to set out briefly the lines on which these experimental chambers are being run, and this at once involves a consideration of the subject of loss in weight.

LOSS IN WEIGHT.

The writer has long been aware of the different treatment apples receive in different cool stores or ships, in different chambers in the same store or ship, and even within the walls of the same chamber. The limited value of a thermometer or two, or even of thermometers and hygrographs, has become more and more obvious. They cannot be dispensed with, but they show little of the actual effects of the storage conditions on the fruit.

The dairying industry has a more perishable product to handle than apples. The industry certainly uses instruments, but the principal "instrument" is the product itself. If the milk was

not quickly cooled or was badly handled in transit the evidence is sought in the milk itself. Milk is rejected, or received and paid for, on its condition. Throughout the whole process of cheese and butter making the milk—or its product—is the main indicator of the effects of past conditions imposed upon it, and of what to do next. This makes for uniformity in the final results with milk from different breeds of cattle, on different farms, and in different factories and stores.

The possibilities of similarly using the living apples as the indicators of the progressive effects of cool storage and as a guide to cool-store management have long appealed to the writer. With this in mind, a start was made in judging the prevailing store-temperatures by a thermometer sunk in the flesh of the apple. Valuable as this guide is, especially early in the storage season when air-temperatures are fluctuating, it soon became plain that the effects of one cool-store condition could not wisely be judged or experimented with apart from the others. Did there exist, therefore, any single physiological result in the apple that was conveniently measurable, and that was affected to some extent by all the factors employed in the production of cool storage for apples?

At this stage the writer made a review of the cool-store factors, from which it appeared that the "loss in weight" of the fruit, while apparently not much affected by ordinary *ventilation*, indicated to some extent the cumulative effects on the fruit of the other cool-storage factors—namely, *circulation*, *temperature*, *humidity*, and *loading*. Thus, firstly, in a cold-air blast system the longer the hours of circulation per day, or the faster (within limits) the circulation, the greater will be the volume of air passing over the fruit, the greater the amount of water carried from the apples, and consequently the greater the loss in weight. Compare eight hours' circulation with sixteen hours' circulation, or the slow circulation of a direct-expansion or a brine-circulation system without a fan with the faster circulation of a cold-air blast system. Secondly, the higher the flesh-temperature the faster the evaporation and respiration, and consequently the greater the loss in weight. Compare the rapid wilting and no flesh-collapse in unrefrigerated sheds with the slower wilting in cool store; or the more rapid wilting and less flesh-collapse in cool stores run at relatively high flesh-temperatures with the absence of wilting and abundant flesh-collapse in cool stores run at low flesh-temperatures. Thirdly, the higher the atmospheric temperature the greater the carrying-capacity per unit volume of air, consequently the greater the loss in weight. Fourthly, the lower the relative humidity the faster the absorption of water, gases, &c., from the apples, consequently the greater the loss in weight. In a chamber where a high carbon-dioxide concentration had accumulated there would, no doubt, often be a high relative humidity and a consequent small loss in weight, notably in chambers without fans on board ship. Fifthly, the smaller the total number of bushels in a chamber the smaller the total volume of water, gases, &c., to be removed; the quicker, therefore (within limits), their removal per bushel, and consequently the greater the loss in weight. The converse may be particularly important where storage is close and holds are tight on board ship, especially where temperatures are high, or where there is no special circulation or water-extracting system as under the brine-circulation system.

From a number of reasons of this kind adduced from the experiments and observations of the last three years it appeared that the circulation, temperature (flesh and atmospheric), humidity, or loading could not be altered without affecting the loss in weight; conversely, the loss in weight could be increased or diminished by increasing or diminishing the circulation, temperature, and humidity or loading, and that an increase in the loss in weight would probably arrest the development of flesh-collapse. What proportion of the total loss in weight might be due to temperature and what to humidity in a given temperature-humidity ratio per hour of circulation and with definite loading was unknown for any chamber. Likewise it was unknown what were the proportions of water, gases, &c., that made up the total loss in weight at different temperature-humidity-circulation ratios.

Seeing, however, that the loss in weight promised to be of some use as an indicator of the composite effects of these four cool-storage factors on the apples, and that an increased loss in weight might reduce the amount of flesh-collapse, it was later decided to attempt to regulate the experimental chambers, using the loss in weight as the indicator as to whether the circulation, temperature, or humidity should from time to time be increased or diminished.

The next question that arose was, What total amount of loss in weight should one aim to secure in the storage season? If the loss in weight could be reckoned as a measure of the physiological activities in the apple it was considered a probable indicator of the rate at which the apple was approaching the end of its commercial or of its natural life; under present circumstances there seemed no urgent need to prolong the commercial life much longer than November—that is, seven to eight months' cool storage. Again, if the larger loss in weight in unrefrigerated stores meant a quicker exhalation of noxious substances from the internal atmosphere of the apple, and consequently no flesh-collapse, then, seeing that one of the objects was to determine whether an increase in the customary losses in weight in cool store would decrease the percentage of flesh-collapse, it was decided to produce by November the maximum loss in weight that could safely be effected without commercial injury to the fruit from shrivelling, rots, or advanced maturity. This maximum loss in weight was first roughly determined by the triplicate loss-in-weight experiments carried out in each of the packing-rooms at natural temperatures and relative humidities. Under these conditions the loss in weight was very rapid, and it was quickly shown that 40 lb. of Sturmers could lose over 1 lb. in weight without any change in their commercial appearance; that 40 lb. of Sturmers could lose 2 lb. of weight without resulting in any commercial damage; that when 40 lb. under these conditions had lost 3 lb. in weight slight shrivelling resulted; and that when 40 lb. had lost 4 lb. the apples were damaged commercially. These results indicated that for the purposes of this experiment the maximum loss in weight by November should be about 40 oz., or $2\frac{1}{2}$ lb., per 40 lb. of Sturmers.

Having decided to effect this total loss in weight between the receipt of the fruit—say, in April—and its despatch from the cool store—say, in November—the next point to speculate upon was the best rate at which to effect that loss in weight month by month. Seeing that

flesh-collapse had formerly appeared early in June—that is, in the first ten weeks of storage—and that the cool-storage conditions previous to that time were believed to have induced this disease, it was decided that a very large proportion of the total loss in weight should be effected in the first six weeks of cool storage, so as to prevent flesh-collapse if it was to be done by this means. Accordingly 24 oz.—which was roughly half the loss in weight in the first six weeks shown to have taken place in the packing-rooms where no flesh-collapse develops—was adopted as the amount of loss in weight for the first six weeks in the experimental chambers. Thereafter the monthly loss was gradually to taper off to the minimum in November.

Seeing now that 24 oz. per 40 lb. of Sturmers had to be extracted in the first six weeks, the next requirement was to decide what hours of circulation, temperature, and humidity would be required to bring this about. The rate of loading was not controlled, and the results now indicate the improvement that could have been made by regulating this factor. As nothing short of an actual trial would determine this point, it was decided in the first two or three weeks of storage to effect as large a loss in weight as it was possible. Thus the experimental chambers had to be run at as high a temperature and as low a humidity as could safely be maintained—adequate ventilation being provided. The following are the reasons on which the theoretical initial flesh-temperature-humidity ratio was decided on :—

Firstly, Winkler, working on the physiological disease known as “internal browning” in the Yellow Newton apple, arrived at the conclusion that in commercial practice it would probably not be expedient to store apples above 5° C. (= 41° F.). Guided by this statement, it was decided to fix the initial flesh-temperature range at 38–40° F. at either of the two points in the chamber midway between the centre of the chamber and the ends, and midway between the ceiling and floor. At either of these two points in a chamber that reversed its air-current regularly would the mean temperature of the store be met with. Secondly, in New Zealand, where the mean recorded temperature from January to December is 53° F., and the mean recorded relative humidity 75 per cent. of saturation, flesh-collapse does not occur among apples stored in ordinary farm-sheds or in unrefrigerated sheds built for the short storage of apples. These meteorological records probably do not represent the true averages of temperature and humidity, but they were the only figures available at the time, and an attempt was made to find how the same loss in weight could be effected at a mean flesh-temperature of 39° F. in the experimental chambers. The problem, therefore, of obtaining in the first two or three weeks the same loss in the experimental chambers as took place in unrefrigerated sheds may roughly be stated as follows: With a temperature of 53° F. and a relative humidity of 75 per cent. of saturation a certain loss in weight takes place outside: how much lower would the relative humidity require to be to effect a similar loss in weight when the temperature is reduced to 39° F.? In other words, when the temperature is 39° F. what relative humidity in the atmosphere will admit of the absorption of the same weight of water per cubic foot of air as is absorbed when the temperature is 53° F. and the relative humidity 75 per cent. of saturation? The answer is, A relative humidity of 59 per cent. of

saturation. Obviously, for several reasons, this figure is only approximate. The loss in weight is not due only to water. Then, again, the problem does not take into account the decreased rate of evaporation at 39° F. as against 53° F., nor does it include the differences in the circulation under natural conditions in ordinary storage-sheds as compared with that in cool stores with a definite circulation outfit. However, it was decided to see what loss of weight would be effected by a flesh-temperature range of 38° to 40° and a relative humidity under the discharge or inlet duct not lower than 60 per cent. of saturation at the end of each day's run.

Summarizing the actual results, it may be said that only occasionally was the relative humidity brought down into the sixties, and the difficulties of getting it down increased as the experimental stores became more fully loaded. The definite weights of Sturmers (30 lb. lots) placed in the experimental and non-experimental chambers were weighed from time to time to ascertain the progressive loss in weight and to enable an idea to be formed of what was the loss in weight of the bulk of the fruit in each chamber. The loss in weight for the bulk was estimated as from a "mean loading-date." This date was set down after considering what was the date midway between the first and last receipts into each chamber, and on what date each chamber was half-filled. A programme was then drawn up showing the weekly losses in weight necessary to secure a total loss of 24 oz. per 40 lb. of Sturmers in the first six weeks, and a total of 40 oz. by the end of the storage season. It was not found possible to secure as great a loss as was desired at the flesh-temperature range of 38-40° in the first six weeks, but later on, when the required loss per week became less as per programme, and better appliances and methods were devised, this deficiency was gradually overtaken. Thereafter, from time to time, the hours of circulation were varied in total length of time, or made intermittent each day (two shifts); the air-current was variously limited at the duct doorways; the flesh-temperature was reduced and the humidity raised by allowing the temperature of the brine dripping over the battery-pipes to become warmer and of lower specific gravity—all this to limit the loss in weight, the problem soon becoming how to keep the rate of loss down.

The loss in weight has fallen from 0.7 oz. per 40 lb. of Sturmers per day during the first week's storage to 0.2 oz. per day at the end of August. As the rate of loss was gradually brought down, so the six first picks at intervals between 2nd March and 2nd June were successively being brought into cool store. Thus the daily rate of loss in weight has been smaller for each successive pick. This will provide an interesting series of different losses in weight, and will also demonstrate one of the irregularities of treatment under commercial conditions in the same chamber where the "loading in" spreads over a long period of time for any chamber; for the greater the load the smaller the loss per bushel. The tendency has been to bring about a greater drying-power and a greater loss in weight, both in the experimental chambers and also in several commercial stores, more or less generally. So far these conditions have been attended with very good results indeed. The experimental stores would have profited by more ventilation. There is a great fear of introducing moisture

in ventilating, and demonstrations were made and tables of equivalent relative humidities worked out to avoid this. When the introduction of water means the snowing-up of battery-pipes and difficulty thereafter in defrosting, this fear may have some justification, for the defrosting of the coils and the extraction of water from the chambers are more difficult when working about 32°. But with higher temperatures and greater drying-power, such as have been in practice this season in certain stores, there is little difficulty in these respects, and the writer is not able to see why any harm should come from a little moisture being brought into a chamber under such circumstances, provided it is extracted, say, in the next twenty-four hours.

Records are being kept of the discharge and flesh temperatures and the relative humidity, and estimations of the daily losses in weight are being made from periodical weighings of the definite weights of apples. While the results to the end of August were most encouraging, it is not claimed that the optimum loss-in-weight programme has been attained. It is confidently believed, however, that if this programme continues to give such good results, then the loss-in-weight figures will enable the programme to be repeated with considerable accuracy in other stores or under other circumstances. An examination, however, of the data collected may show where improvements could be made during the coming season.

At the commencement of the storage season it was considered that much of the ordinary commercial space would be run on lines similar to, or differing only a little from, those of past years, and consequently that marked differences in the temperature-humidity ratio, and therefore in the losses in weight, would prevail here as compared with the experimental chambers. The controls were on this account set up in the non-experimental space. The tendency of the store-proprietors, however, has been from time to time to bring the conditions of the non-experimental chambers more closely than was anticipated to those of the experimental chambers. It remains to be seen how much this will affect the controls and interfere with the evidence of the experiments from a scientific standpoint.

EXPLANATION OF TERMS.

In the course of this article use has been made of several terms that require a little explanation.

(a.) "Wilt": A freshly gathered apple is hard to the touch. When pressed firmly enough with the thumb it yields, and when it yields the tissue ruptures. There is little or no resiliency. When, however, an apple is wilted through loss in weight its hardness gradually decreases. In the case of Sturmers it was found that the decrease in hardness was only barely perceptible to the touch when the loss in weight had reached 20 oz. per 40 lb. of fruit (= 3 per cent.). Resiliency at this stage was perceptible when the stored apple was compared with one freshly gathered from the tree. The tissues when pressed with the thumb yielded, but were not quite so liable to rupture. Such fruit would carry better than fresh fruit. The term "wilt" is meant to include this condition from the time it is first perceptible to the touch onward to a certain point just before the skin first shows signs

of wrinkling. Therefore the wilted apple is not wrinkled or shrivelled, and is therefore not damaged commercially in this way.

(b.) "Shrivel": When the loss in weight in Sturmers reaches about 32 oz. per 40 lb. of fruit (= 5 per cent.) the first signs of shrivelling in a case are liable to appear, more especially on apples adjacent to the thick wooden ends. The amount of shrivelling, however, is only very slight, and late in the season one would commonly find apples decidedly more shrivelled selling readily at good prices. Very little increase in the amount of shrivel was noticeable, even when as much as 40 oz. per 40 lb. of fruit (= 6 per cent.) had been lost. A general condition of shrivel in a case is regarded as a commercial detriment to the fruit, and this is liable to occur when a greater loss in weight than that just stated is effected. Nevertheless the writer has a number of records in his notebook of only slight commercial damage occurring after a loss in weight of 48 oz. per 40 lb. of fruit (= 7.5 per cent.).

(c.) "Loss in weight": This expression is specific enough in itself, inasmuch as it covers no more than the actual weight by which the fruit is reduced. The expression has no reference to the nature or the proportion of the various constituents which leave the fruit and thus reduce its weight, and herein lies a most promising field of inquiry. While two entirely different ventilation-temperature-humidity ratios could effect precisely the same loss in weight, there are reasons for suspecting that such identical losses in weight would not be composed of the same proportions of water, carbon dioxide, esters, &c. If this be true, then the temperature-humidity ratio may possibly be adjusted not only to increase or decrease the total loss in weight, but also to increase or decrease the evolution of any of the constituents which are lost. One of the problems that presses for an answer may now be enunciated as follows: If identical weights of a certain apple-variety are exposed to different temperature-humidity ratios which effect the same total loss in weight, what are the proportions of the various substances which leave the fruit for each ratio?

(d.) "First pick": It will be noted that six "first picks" were made. The object of this was to demonstrate the best stage at which to *start* picking Sturmers. An attempt was therefore made to secure six positively different stages of maturity, and to ensure this a large number of trees on even ground were set aside for the experiment. Every time a pick was made a fresh set of trees was used, and from each set of trees the most advanced or the ripest fruits were selected. This meant that not only was each successive pick made because the fruit looked more mature, but also because the fruit had actually been on the tree longer and therefore was more mature—the fruit of each pick coming from corresponding positions on different but adjacent sets of trees, thus securing uniformity. A large proportion of the fruit of each tree was taken at each pick, leaving a smaller proportion which included the fruit low down among the forks of the main branches, where ripening is slow and even the texture of the flesh appears distinctive. Each of these six picks was therefore a "first pick" for the set of trees off which the fruit was taken, and thus there were six "first picks."

(e.) "Second pick": The "second picks" were made from trees off which "first picks" had been taken. The fruit had a distinctive appearance, as much of it came from low down on the tree and on the inside where it was less exposed to the sun.

APPRECIATION.

The experiments this year are somewhat extensive, and their success to date has been accomplished by virtue of the hearty co-operation of a number of fruitgrowers and others who are deeply interested in cool storage. My thanks are due to the growers—some twenty in number—who volunteered large quantities of their fruit for experimental purposes, and more particularly to Messrs. R. B. Jackson, of Nelson, and W. E. Rowling, of Riwaka, who contributed a large number of cases of fruit to be cut up from time to time for examination. I must also thank the directors of the Nelson Freezing Company and the Motueka Cool Storage Company for the storage facilities they have afforded me, and Messrs. N. B. Brown, T. Morgan, A. Ercolano, the refrigerating engineers at Stoke, Motueka, and Port Nelson respectively, for their co-operation and willing assistance at all times. Finally, I desire to acknowledge the advice and assistance I have received from my fellow-officers, Messrs. G. Stratford and J. H. Thorp, the local Orchard Instructors, and also Mr. W. C. Hyde, Horticulturist, who has been closely associated with me throughout the investigation.

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ALBANY EXPERIMENTAL AREA.

OPERATIONS IN 1923-24.

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THE earlier stages of the 1923-24 season in the Auckland District proved distinctly unfavourable to the working of gum-land soils. The winter and early spring were too wet to permit of seasonable cultivation, while the dry weather following baked the soil hard. Somewhat droughty conditions continued up till March, when a humid autumn set in. These conditions served to demonstrate the drought-resisting qualities of kikuyu grass, paspalum, Japanese millet, and, to a less extent, of mangolds and cabbages.

ROOT CROPS.

Mangolds had to be sown twice, but then grew fairly well right through the season. Black-rot (*Phoma betae*) made its appearance, somewhat reducing the crop and rendering the harvested roots hard to keep. Top-dressing with 1 cwt. of nitrate of soda per acre (on

12th December) gave disappointing results, the yields per acre being as follow :—

Variety.			Not top-dressed. Tons.	Top-dressed. Tons.
Jersey Queen	..	..	17.8	18.4
Yellow Globe	..	..	14.6	13.3
Long Red	..	..	18.5	18.7

The Long Reds, as usual, proved the best keepers.

A small test referring to the application of manure was also carried out, the fertilizers used being 3 cwt. superphosphate and 1 cwt. blood-and-bone per acre. The result can be expressed as follows :—

Manure sown in same drill as seed	..	..	100
Manure sown broadcast before drilling	..	..	135
Manure sown in drill 2 in. to one side of seed-drill	..	..	94

While this experiment cannot be regarded as being in any way conclusive, it does at least suggest a line of research that might very profitably be followed up, not only with mangolds but with other crops.

Carrots also had to be resown, but made a fair crop.

Soft Turnips were quite successful. Webb's Purple-top yielded the heaviest crop, but Webb's Invincible (yellow-fleshed) gave the best quality, and kept sound considerably longer. Devonshire Grey-stone and Imperial Green Globe were also quite satisfactory, and kept well.

OTHER CROPS.

Cabbages.—This crop once again proved its suitability for clay soils in a dry summer. Though badly attacked by diamond-backed moth, the yield was excellent (about 20 tons per acre), considering that the variety was Early Drumhead, selected for early maturity rather than yield. It is surprising that small dairy-farmers on the gum-lands do not make use of this excellent fodder crop. Cabbages can be raised in a seed-bed and planted expeditiously with the plough. It should be possible to arrange a succession from March to August.

Potatoes.—Experiments with selected seed were continued, but with indifferent results. The first crop was vigorous in the haulm, but yielded very poorly; the second suffered badly from an attack of *Phytophthora infestans* blight during the heavy autumn rains. It is fairly safe to assume that the land is unsuitable for the cultivation of potatoes, more especially when it has been cropped for a number of years.

Japanese Millet and Red Clover.—This was quite a successful crop, though, owing to the dry summer, the clover was not particularly prominent until the late autumn, after the millet had been cut for hay. This should be a useful means of utilizing land after a crop of millet has been taken, the clover providing feed and green manure preparatory to grass-sowing the following autumn. The best results were obtained by drilling a mixture of 12 lb. Japanese millet and 6 lb. red clover. This experiment will be repeated on a grazing basis.

Kikuyu Grass (*Pennisetum clandestinum*) — This grass did well, coming away in early October and growing steadily till late in July. The kikuyu and Lotus-major plot was particularly strong, with the kikuyu and white clover a good second. The pure kikuyu plots were again unproductive owing to sod-binding and nitrogen-exhaustion, but responded well to nitrate of soda.

On a plot planted in spring with kikuyu and paspalum the former was well ahead throughout the season, though the paspalum will probably thicken out next year.

MINOR PLOTS.

On the smaller plots kudzu vine again failed to come up to expectations, and honey-locust did not germinate. Japanese millet and spring tares proved a useful forage mixture, and several varieties of maize were grown. Owing to their miniature size and proximity to the shelter-belt these plots were harried by small birds (sparrows, larks, and Californian quail).

COTTON.

Durango cotton was again tried, but failed to grow satisfactorily till the really warm weather arrived. It was badly attacked both by root-fungus and *Phytophthora infestans*, and though many bolls were formed none reached maturity. It would appear that this crop is not as yet an economic possibility in the Auckland Province, though possibly cotton could be obtained by raising the young plants in a cold frame and planting out in November.

SULPHUR AND PHOSPHATE EXPERIMENT.

In order to obtain some light on the availability of insoluble (tribasic) phosphates in rock phosphate when used in conjunction with sulphur, either free or combined, trials were carried out, using blue lupins and soft turnips as subjects. The lupins were decimated by a root-fungus and had to be ploughed in; the turnips gave a purely negative result. It is possible that in the dry weather prevailing almost throughout the experiment the manures had a depressing effect.

TOP-DRESSING OF PERMANENT PASTURE.

Experiments on the Albany showground were continued, the plots being manured in June and cut for hay on 30th November. There was no outstanding difference between the various plots, but the yield and quality of herbage of the whole of the manured area were in marked contrast to the surrounding unmanured pasture. A portion of each plot was top-dressed with 1 cwt. of nitrate of soda per acre in September. These sub-plots appeared to be more vigorous and of a darker colour.

LAYING DOWN LAND IN GRASS.

Seeing that the area has now been used for many years for manurial and other experimental work, and owing to the expense and uncertainty of cropping small plots over a number of years, occasioned by disease, bird-attack, and the necessity for employing a team by contract, it has been deemed advisable to lay down about half the land in grass of a more or less permanent nature. It had been intended to sow grass last autumn, but late removal of crops, followed by wet weather, delayed the operation, which was carried out in September. This area has been sown in various mixtures, including wild white clover imported from England. It should now be possible to fence off and graze all grass-plots instead of being compelled to cut them.

BOYS' AND GIRLS' AGRICULTURAL CLUBS.

TARANAKI, WANGANUI, AND FEILDING DISTRICT COMPETITIONS, 1923-24.

J. W. DEEM, Instructor in Agriculture.

THESE competitions were carried out last season on similar lines generally to those of previous years. The Farmers' Union, individual farmers, and officers of the Education and Agriculture Departments again co-operated in control. The root-growing consisted of mangolds and carrots in North and South Taranaki, and mangolds in the Wanganui and Feilding districts. Calf clubs were again confined to Taranaki. The poultry club which had been started at New Plymouth lapsed during the season, but is expected to be set going again this year. Altogether a total of seventy schools took part in these competitions.

ROOT-GROWING.

The season was somewhat irregular for root-growing. Mangolds did well, except that in some places they suffered a little from heart-rot. Carrots promised to be good, but suffered severely in exposed positions from a salt-laden westerly storm in March, which cut the tops back badly and stopped root-development, considerable numbers rotting. This trouble was responsible for the falling-off in the carrot averages. On the whole, cultivation showed marked improvement, and in some of the schools that had been competing for two or more years it was almost perfect. In this connection special mention should be made of Motunui School, in North Taranaki, and Rawhitiroa, in South Taranaki. Five out of nine plots at Motunui gained full marks for cultivation, while the others were only a few points behind. Rawhitiroa started out with thirteen plots, and presented the same number of first-class plots to be judged. Material for a total of 544 plots was supplied to competitors, and of this number 335, or 61.5 per cent., were presented in a creditable condition for judging. A large number of plots were ruined by stock gaining access to them before judging-time. Unfortunately, the parents are to be blamed in these cases, and regret must again be expressed that there are some who appear to take no interest in the movement and will not assist their children in protecting their plots. It is found that where the parents and teachers are interested the work is a success, but where this support is lacking the results are very moderate.

The heaviest mangold crop was 138 tons 13 cwt. per acre, against 132 tons 5 cwt. in the previous season. This very fine crop was grown by Jean Miller, of Oeo, Taranaki, who also wins the Stuart Wilson Cup and the Agriculture Department's gold medal for the best crop grown in any of the school competitions throughout the Dominion. The average for all the mangold crops was 56 tons 14 cwt., against 48 tons 1 cwt. in the previous season.

The champion carrot crop—58 tons 10 cwt.—was grown by Freda McNeill, of Rawhitiroa. As already mentioned, the season was not

a good one for carrots, and the average crop in these competitions was only 28 tons 7½ cwt., compared with 36 tons 8 cwt. in the preceding year.

The placings for the championships are as follow:—

North Taranaki: Mangolds—Tom Graham, Waitara, 1st, weight 108 tons per acre, total points 188½; Monty Honeyfield, Tataraimaka, 2nd, 102 tons 4 cwt., total points 181; Frank Larsen, Okato, 3rd, 90 tons 10 cwt., total points 180½. Carrots—Merle Bowan, Egmont Village, 1st, 46 tons, total points 126; Fannie Topine, Waiau, 2nd, 28 tons 15 cwt., total points 124½; Dave Blanchard, Tariki, 3rd, 34 tons 1 cwt., total points 120. The prize for the best-kept plot was divided between Donald McKenzie, Joe McKenzie, and Winnie McKenzie, Motunui. These plots were practically perfect, and the judges were unable to separate them.

2 cwt., total points 221; Bernard Taylor, Ngaere, 3rd, 108 tons. South Taranaki: Mangolds—Jean Miller, Oeo, 1st, 138 tons 13 cwt., total points 234½; Olive Warner, Matapu, 2nd, 127 tons 10 cwt., total points 203½. Carrots—Freda McNeill, Rawhitiroa, 1st, 58 tons 10 cwt., total points 150½; Beatrice Oldfield, Okaiawa, 2nd, 45 tons 10 cwt., total points 143½; Alma Cornish, Toko, 3rd, 42 tons 10 cwt., total points 136½.

Wanganui—Feilding: Ivy McKay, Wangaehu, 1st, 131 tons 2 cwt., total points 216; Rona Field, Taikorea, 2nd, 100 tons 8 cwt., total points 190; Flora White, Glen Oroua, 3rd, 104 tons 6 cwt., total points 190. It is worthy of note that Flora White's two sisters, Elsie and Alison, were first and third respectively last year.

The Manawatu, Feilding, and Wanganui executives of the Farmers' Union gave a challenge shield for the school gaining the most points in the district competitions. This was won by Glen Oroua last year. Three schools tied for it in 1923-24—namely, Rongotea, Colyton, and Apiti.

A fine massed display of roots from a large number of the competing plots was made at the New Plymouth, Hawera, and Palmerston North winter shows. Competitive classes were also provided at these shows for club members. These attracted good entries, and afforded an opportunity of instructing the competitors in root-selection.

CALF-REARING.

Calf-club entries equalled those of the previous season, and the number brought forward for judging was rather better—237 against 200. All the calves were grade heifers, and were divided into two classes, one for Jersey or Ayrshire crosses and the other for Shorthorn or Friesian crosses. The number of calves judged in the different classes were Jersey and Ayrshire, 190; Shorthorn and Friesian, 47. At some centres, in addition to the judging for the calf-rearing competition, the calves were judged on dairy type, and this provided instruction to the competitors in selection on type. Many of the yearling and two-year-old heifers reared in previous competitions were also brought forward for judging on these occasions.

This year (1923-24) the 100 points previously allowed for cost of rearing was reduced to 50. This worked better, but it may be

necessary to still lower the points in order to get satisfactory results. Where liberal points are allowed for cost there is a tendency to use foods not enumerated in the schedule and for which no charge is made. For instance, it was found this year that one calf which showed a very low cost for rearing had been fed liberally on potato-water. The highest cost of rearing a calf in South Taranaki was set down this year at £3 1s. 10d., against £2 2s. 6d. in the previous year; the lowest at 3s. 5½d., against 3s. 6d.; and the average at 16s. 2½d., as compared with 16s. 10d. It should be understood that in these charges no allowance is made for grass or labour. On the basis of 50 points for cost of rearing, one point is deducted for every 1s. of cost; thus if a calf cost 30s. for food 20 points are allowed. Other points are 40 for records and 100 for condition.



JUDGING CALVES AT RAWHITIROA, SOUTH TARANAKI COMPETITIONS.

The championships resulted as follows:—

North Taranaki: Jersey and Ayrshire class—Dorothy Raven, Newall, 1st, total points, 166½; Alan Washer, New Plymouth, 2nd, 160½ points; Madge Flintoff, Durham Road, 3rd, 151½ points. Shorthorn and Friesian class—Dudley Thompson, Hillsborough, 1st, 139½ points; Vera Lambert, Bell Block, 2nd, 133½ points.

South Taranaki: Jersey and Ayrshire class—P. Wakelin, Toko, 1st, 180 points (food used, new and skim milk, cost 12s. 4½d.); L. Gernhoefer, Rawhitiroa, 2nd, 177 points (new and skim milk, 14s. 6d.); M. Reid, Matapu, equal 2nd, 177 points (new milk, whey, and barley water, 13s. 1½d.); Jane Keighley, Matapu, equal second,

177 points (new milk and whey, 10s. 3½d.) Shorthorn and Friesian class—J. Glen, Ohangai, 1st, 184 points (new milk and whey, 3s. 5½d.); Phyllis Wood, Rawhitiroa, 2nd, 176 points (new and skim milk and Faterine, £1 os. 0½d.); C. O. Connor, Matapu, 3rd, 169 points (new milk and whey, 11s. 0½d.).

Classes are also provided by the various Taranaki agricultural and pastoral associations at their summer shows for club competitors, and this provides a further opportunity for bringing the calves together and preparing notes.

TESTING OF EXPORT BUTTER FOR WATER CONTENT: YEAR 1923-24.

Dairy Division.

THE subject of water content in export butter and the inauguration of an extended official testing system for the Dominion were dealt with in an article published in the *Journal* for October, 1923. Commencing with August of that year—the opening of the 1923-24 season—one box of butter from each churning in the lines received at the grading-stores has been tested for content of water. During the dairy-industry year, August, 1923, to July, 1924, inclusive, a total of 126,095 churnings has been tested. The operation of the system appears to have checked the export of butter containing excessive moisture, inasmuch as no complaints with respect to such were received from overseas markets last season, this being in marked contrast to the number of complaints received in 1922-23.

The results of the testing are shown in the following tables:—

Table 1. *Butter tested for Water Content, August, 1923, to July, 1924.*

Month.	Number of Samples containing up to 16 per Cent. of Water.					Average Water Content.
	Creamery.	Whey.	Dairy.	Milled.	Total.	
August	1,521	87	..	..	1,608	Per Cent. 14·47
September	4,548	601	..	19	5,168	14·81
October	12,244	1,060	..	18	13,322	15·00
November	17,856	1,206	I	61	19,124	14·89
December	17,804	1,166	..	50	19,110	14·93
January	16,698	1,222	..	51	17,971	14·92
February	13,044	1,118	..	31	14,193	14·99
March	11,479	969	..	25	12,473	15·04
April	8,984	804	..	25	9,813	15·00
May	7,234	711	..	32	7,977	14·87
June	2,494	80	..	22	2,596	14·81
July	1,485	18	..	55	1,558	14·73
Total for twelve months	115,481	9,042	I	389	124,913	14·932

Total butter graded containing up to 16 per cent. of water, 2,472,440 boxes, or 61,811 tons.

Table 2. Summary of Tests up to and over 16 per Cent.

Month.	Percentage of Tests up to 16 per Cent.			Percentage of Total Tests.
	Under 14 per Cent.	14 to 15.5 per Cent.	15.6 to 16 per Cent.	Over 16 per Cent.
August	16.92	73.88	9.20	0.80
September	13.00	72.00	15.00	1.007
October	7.50	73.50	19.00	1.38
November	6.73	78.53	14.74	1.39
December	6.77	79.84	13.39	0.83
January	7.09	78.61	14.30	0.79
February	5.24	80.68	14.08	0.82
March	4.98	80.63	14.39	0.79
April	4.69	82.76	12.53	0.59
May	8.40	77.89	13.70	0.48
June	10.70	76.57	12.71	0.80
July	18.35	67.26	14.37	1.01
Average water content, 14.932 per cent.			Average water content, 16.38 per cent.	

Table 3. Number of Samples containing over 16 per Cent. of Water (Butter returned to Factories).

Month.	Creamery.	Whey.	Dairy.	Milled.	Total.	Average Water Content.
						Per Cent.
August	13	..	..	..	13	16.61
September	51	5	..	..	56	16.39
October	182	5	..	..	187	16.37
November	230	16	..	22	268	16.40
December	149	13	..	..	162	16.35
January	134	10	..	..	144	16.43
February	108	9	..	..	117	16.36
March	87	13	..	..	100	16.39
April	56	3	..	..	59	16.36
May	36	3	..	..	39	16.45
June	21	..	..	..	21	16.44
July	16	..	..	..	16	16.45
Total for twelve months	1,083	77	..	22	1,182	16.38

Proposed Staining of Imported Lucerne-seed.—At a meeting of the Board of Agriculture held last month, this question was brought up for consideration by Mr. McLennan, the Auckland Grain, Seed, and Produce Merchants' Association having requested him to place the matter before the Board. Due consideration was given to the fact that the proposed measure, if adopted, would possibly benefit to some extent the Marlborough growers of lucerne-seed, but the Board hoped to see an increase of lucerne sown in the Dominion, and the staining of imported seed would tend to raise the price, which would militate against an increase of the acreage put down. The Board had evidence that the quantity of lucerne-seed imported was small, and that the majority of it was good seed coming from South Africa and Australia. It was suggested that if the Government legislated in the matter the staining should be required to be done in the country of origin. The Board finally resolved to meanwhile take no action, but if necessary at a future date to give the subject further consideration.

A RECONNAISSANCE SURVEY OF PUMICE SOILS.

ROTORUA COUNTY.

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

I. MAMAKU.

THE rhyolitic pumice soils of this country differ from other soils in their newness in every respect — agriculturally, geologically, and chemically. Pumice soils are among the latest to be occupied for farming purposes; in a geological sense the pumice is something of comparatively recent origin; while to the agricultural chemist the vesicular and slaggy particles of pumice, having undergone comparatively little of that weathering, oxidation, sorting, and compaction which has been the fate of normal soils, are therefore regarded by him as something of the newest kind.

The Mamaku sandy silts are apparently derived from a similar material to the lowest subsoil, a coarse pumice sandy gravel now of a yellowish colour, which lies from 4 ft. to 5 ft. below the surface directly on the country rock and follows its contours. The pumice-deposit is therefore wind-borne. The nature of the country rock is still open to investigation, but the numerous brecciated necks or pillars point to its being a lava-flow, the alternative theory being that it is a consolidated tuff. The fact that the pumice gravel is not separated from the country rock by any parting of weathered rock, soil, or organic remains of vegetation is highly significant.

The coarseness of pumice soil is the most disconcerting feature to the chemist. According to Hall and Russell ("Soil Surveys and Soil Analyses," *Journal of Agricultural Science*, p. 209, vol. 4, 1911-12), waste and common lands unsuitable for cultivation are characterized by two properties — the presence of (1) large amounts of coarse sand or of coarse sand and fine sand together, and (2) small amounts only of clay and fine silt. The combined results for fine and coarse sand given in these authors' examples of unsuitable soils range from 50 to 88 per cent., the coarse sand from 12 to 68 per cent., the fine sand from 18 to 64 per cent., the silt from 2 to 16 per cent., the fine silt from 2 to 8 per cent., and the clay from 0.2 to 3 per cent.

If we compare these figures with those yielded by the tawa-rimu type of pumice soil given in the accompanying tables it will be seen that if the size only of the particles composing the soil is considered these soils would come very near those stigmatized by Hall and Russell as unsuited for cultivation. The mitigating circumstance in connection with pumice is that, being of a vesicular or highly porous character, and, further, being a mixture of silicates instead of pure silica, it is more easily affected by the weathering agencies of time and by physical and chemical processes incidental to cultural operations than ordinary coarse sandy soil mainly composed of quartz (pure silica); so that with time, working, and the incorporation of organic manures and suitable inorganic artificial fertilizers, pumice soils may be expected to increase greatly in productiveness. The necessity for considering the coarsest type of air-borne pumice

soils as something requiring exceptional treatment must, however, be realized when the figures for the mechanical analyses are studied in comparison with other normal soils and the abnormal soils already referred to even when the favourable humid and equable temperate climate is taken into account.

A mass of pumice buried in the soil will in the course of years naturally disintegrate or, as it is locally termed, "rot," liberating much of the plant-food which is locked up in the vitreous particles; but in order to produce a healthy normal soil the porous nature of the resulting material must be lessened by compacting and by filling up the interstices with decayed plant-remains. The improved quality of sample S 60 as shown by the chemical analysis is doubtless due to the swampy conditions which have prevailed, a rare occurrence in pumice soils, producing a colloidal or plastic soil out of a coarse sand by the aid of plant-remains.

A feature shown by the Mamaku soils is the constant mechanical composition over a very large area. The analysis suggests that within a radius of two miles and a half from the Mamaku Railway-station there is no change except in isolated patches similar to that represented by S 60. This country all bears, or has borne, a virgin forest of tawa and rimu.

Travelling north, as one gets near the Oturoa Road, about five miles from Mamaku, an improvement is noticeable in the texture of the soil, which is much heavier, the coarse pumice being buried under finer material than that which occurs near Mamaku. A little to the north of the Oturoa-Rotorua Road the beech ("birch" of the settler) forest of the Mangorewa-Kaharoa Block is encountered, and here the soil is so perceptibly finer as to necessitate a new name, being now a "sandy loam" instead of a "sandy silt." The former weighs 10 per cent. more than an equal volume of the latter.

In making this reconnaissance care has been taken to eliminate local variations by drawing each sample from distant points in the same type of country. Thus on the birch country the soil has been drawn from three different sawmillers' areas along a five-mile line. The close correspondence of the results in each set of figures for the mechanical analysis indicates that each type is constant over a large area.

A most interesting fact elicited is the correlation of the composition of the soil with the type of vegetation growing upon it. Thus this typical birch forest is not in this area found off the sandy loam, while the tawa-rimu forest occupies the sandy silt. There are indications, however, that the latter forest is invading the area of the former, which is a forest evidently overmature.

The native vegetation found growing on pumice soils may be either lichens, mosses, mat-plants, fern, tussock, scrub, or forest. Forest is the class of vegetation covering that portion of the Patetere Plateau near Mamaku. The forest is of two distinct types. The type most important — because of its extent — is the tawa (*Beilschmiedia tawa*)-rimu (*Dacrydium cupressinum*) forest, the other type being the southern-beech forest ("birch"), the chief trees of which are *Nothofagus fusca* (red "birch") and *N. Menziesii* (Southland or brown "birch"). The tawa-rimu forest occurs over a very large area of country, extending far beyond the limits of the area.

described in this paper. The type at Mamaku is extremely uniform in its botanical composition. One may walk for miles through this forest without encountering any variation in the species of trees, shrubs, and herbs which go to make up the indigenous plant covering of this district. Any variety met with is only to be found in the introduced element. A very serious occurrence is the rapid invasion of the blackberry, which spreads apace in all unoccupied areas such as disused tramways. The country is traversed in every direction by the tramways of the various timber concerns which are, or were, working in the district, and the monotony of the forest is a matter which cannot fail to strike the observer who follows these ways. Tawa is pre-eminently the dominant forest-tree. Of the amount of millable timber present in the virgin forest, 75 per cent. is tawa and only 25 per cent. rimu (red-pine). This information, imparted by the most experienced sawmiller in the district, may be taken as indicating the proportion of tawa to rimu in the forest. The leaves of the tawa growing on Mamaku soil have a yellowish-green appearance, which is different from the healthy green colour of the leaves when the tree is found growing on Wellington soils.

Other trees of this forest are tawhero (*Weinmannia racemosa*), rata (*Metrosideros robusta*), pukatea (*Laurelia novae-zelandiae*), hinau (*Elaeocarpus dentatus*), pokaka (*E. Hookerianus*), rewarewa (*Knightia excelsa*), miro (*Podocarpus ferrugineus*), kahikatea (white-pine—*P. dacrydiodes*), matai (black-pine—*P. spicata*), maire (*Olea lanceolata*), tanekaha (celery-pine—*Phyllocladus trichomanoides*). This latter occurs very sparsely throughout the forest, and is often confused with the toatoa (*P. glauca*), quite a different small tree of the *Nothofagus* forest. Another tree only occasionally to be met with—the writer knows of it only on the Rotorua-Oturoa Road—is the mangeao (*Litsea calicaris*).

The abundant small trees and shrubs and lianes are best enumerated* in alphabetical order: *Aristotelia racemosa* (wineberry), *Alseuosmia macrophylla*, *Brachyglottis repanda* (rangiora), *Coprosma grandifolia*, *C. lucida*, *C. robusta*, *Coriaria ruscifolia*, *Drimys colorata* (horopito), *D. axillaris*, *Fuschia excorticata*, *Griselinia littoralis*, *Gaultheria rupestris*, *G. antipoda*, *Ixerba brexioides*, *Geniostoma ligustri-folia*, *Leucopogon fasciculatum*, *Leptospermum scoparium* (rare), *Muehlenbeckia complexa*, *M. australis*, *Myrsine salicina*, *Melicytus ramiflorus* (mahoe), *M. lanceolatus*, *Metrosideros hypericifolium*, *M. florida*, *M. scandens*, *Melicope simplex*, *Panax arboreum*, *P. anomalum*, *P. Edgerleyi*, *Parsonsia heterophylla*, *Pseudopanax crassifolium*, *Pittosporum tenuifolium*, *P. cornifolium*, *Quintinia serrata* (rare), *Rhipogonum scandens* (supplejack), *Rubus australis*, *R. schmidelioides* (lawyers), *Senecio Kirkii*, *Schefflera digitata*, *Veronica salicifolia* var.

The ferns and herbaceous plants which occupy the floor of the forest or clearings in it, and sometimes are raised conspicuously above it, are also here enumerated in alphabetical order: *Acaena sanguisorbae* var. (piripiri), *Arundo conspicua* (toetoe), *Asplenium flaccidum*, *Astelia nervosa*, *A. Solandri*, *Cyathea medullaris*, *C. dealbata*, *Danthonia semiannularis*, *Davallia novae-zelandiae*, *Dianella intermedia*, *Drosera binata*, *D. auriculata*, *Earina suaveolens*, *E. mucronata*, *Epilobium pubens*, *E. erectum*, *Gahnia pauciflora*, *G. Gaudichaudi*, *Gnaphalium luteo-album*, *G. involucreatum*, *Gleichenia dicarpa*, *Hymenophyllum*

(several species), *Hemitelia Smithii*, *Juncus bufonius*, *Lomaria capensis*, *L. discolor*, *L. fluviatilis*, *L. lanceolata*, *Lygodium articulatum* (local), *Lycopodium volubile*, *Lagenophora pumila*, *Microtis porrifolia*, *Microlaena avenacea*, *Nertera dichondraefolia*, *Pteris incisa*, *Poa caespitosa*, *Polypodium Billardieri*, *P. punctatum*, *P. pennigerum*, *Pimelia laevigata*, *Pterostylis Banksii*, *Schoenus* sp., *Todea hymenophylloides*, *T. superba*, *Thelymitra* sp.

The second type of Mamaku forest contains as the dominant trees the two species of *Nothofagus*, *N. fusca* and *N. Menziesii* ("birch"), and a common small tree *Phyllocladus glaucus* (toatoa), three plants which do not occur at all in the tawa-rimu forest. Other points of difference are that the small trees *Quintinia serrata* and *Elaeocarpus Hookerianus* (pokaka) are common in the *Nothofagus* forest, and sphagnum bogs are met with. On the other hand, *Phyllocladus trichomanoides* has not yet been observed in the *Nothofagus* forest. This type occurs in the area known as the Mangorewa-Kaharoa Block, lying to the north of the main Rotorua-Tirau Road, when it

TABLE 1. MECHANICAL ANALYSES.

(Results, except S 184-186, are percentages on air-dried soil.)

Laboratory No.	Description of Soil. (Classification of United States Department of Agriculture, modified.)	Analysis of "Fine Earth" passing 2 mm. Sieve.								Stones and Gravel.
		Fine Gravel.	Coarse Sand.	Fine Sand.	Silt.	Fine Silt.	Clay.	Moisture.	Loss on Ignition.	
"Birch" Soils.										
R 1123	Sandy loam	0.8	15.6	23.4	23.8	11.2	3.0	3.6	17.8	5.0
R 1126	"	0.8	15.6	26.8	23.8	11.1	3.4	3.0	14.7	5.5
R 1138	"	1.3	15.5	19.9	21.8	13.3	4.2	4.4	16.4	Trace.
R 1140	"	2.0	17.3	19.8	21.5	12.6	4.0	4.3	16.8	"
R 1142	"	2.1	19.9	23.8	19.8	8.3	3.1	3.8	17.6	"
S 184	"	1.3	12.9	16.3	15.0	11.1	2.3	31.3	9.6	6.5
S 186	Fine sandy silt	1.3	9.6	27.1	23.2	10.4	1.4	10.4	16.0	2.0
S 188	Silt	0.3	4.2	21.5	40.3	15.0	2.8	4.3	10.8	3.2
R 946	Sandy loam	1.2	19.7	23.8	19.4	10.7	3.6	3.4	15.8	4.5
R 947	Sandy silt (subsoil) ..	0.4	33.2	27.8	15.5	6.1	1.8	3.1	9.6	Trace.
Tawa-Rimu Soils.										
R 985	Sandy silt	2.0	23.7	23.9	20.5	7.9	2.4	7.1	13.3	Trace.
S 988	"	1.5	29.5	22.1	16.7	7.3	2.2	8.1	14.1	"
S 181	"	1.3	30.5	27.4	18.6	8.5	2.3	1.6	9.8	4.5
S 182	"	1.1	30.5	26.0	17.7	8.5	1.2	3.1	11.5	3.5
S 173	"	1.4	28.9	24.7	17.7	7.6	2.8	2.4	13.7	2.1

Locality References.

- R 1123: Forest adjoining birch forest, Kaharoa-Mangorewa Block.
 R 1126: Birch forest adjoining above soil, Waihi Company's tram.
 R 1138: Newly grassed birch country, Oturoa (Muir's).
 R 1140: Old grassed birch country, Oturoa (Muir's).
 R 1142: Same type as previous—not birch country (Williams's).
 S 184: Birch forest, Gamman's cutting.
 S 186: Tirau paddock, upper terrace.
 S 188: Tirau paddock, lower terrace.
 R 946: Birch forest, same locality as R 1126.
 R 947: Subsoil of R 946.
 R 985: Railway cutting, Mamaku, 700 ft. above Lake Rotorua.
 S 988: Scenic reserve adjoining Mamaku Demonstration Farm.
 S 181: Forest, Demonstration Farm.
 S 182: Scenic reserve adjoining Demonstration Farm.
 S 173: Demonstration Farm (cultivated soil).

TABLE 2. CHEMICAL ANALYSES.
(Results, except *, are percentages on soil dried at 100° C.)

Laboratory No.	Locality.	Volatile Matter.		Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method; Hall's Modification ("Available" Plant-food).						Hydrochloric-acid Extract ("Total" Plant-food).			Hydrogen-ion Determination.		Fe (Iron) extracted by 1-per-cent. Citric Acid.
		* On Air-drying.	* At 100° C.		Ignition.	Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphoric Acid, P ₂ O ₅ .	pH Value.		
<i>"Birch" Soils.</i>																
R 946	Mangorewa - Kaharoa Block, Waihi Company's cutting	39	3.36	16.10	0.231	0.048	0.013	0.004	0.003	0.13	0.15	0.02	0.02	5.5	0.194	
R 1123	Forest adjoining birch forest (1126)	44	3.82	19.58	0.419	0.059	0.013	0.021	0.006	0.21	0.16	0.07	0.03	4.8	0.097	
1126	Birch forest, Waihi cutting	38	3.22	14.67	0.208	0.044	0.017	0.014	0.005	0.20	0.17	0.04	0.02	4.8	0.130	
1138	Muir's, Oturoa Road, formerly birch forest	43	4.56	17.43	0.349	0.138	0.020	0.029	0.003	0.27	0.18	0.10	0.04	5.7	0.069	
1149	Muir's (grassed fourteen years)...	35	3.80	17.83	0.358	0.200	0.028	0.014	0.003	0.46	0.18	0.02	0.03	5.7	..	
1142	Williams's, Oturoa Road (twenty-six years)	12	4.26	17.65	0.405	0.113	0.022	0.016	0.003	0.37	0.19	0.08	0.05	5.9	0.039	
1156	Mangorewa-Kaharoa Block birch forest, Waihi Company's cutting	49	4.22	23.10	0.339	0.110	0.021	0.015	0.002	0.24	0.16	0.05	0.02	4.8	0.193	
S 184	Birch forest, Gamman's cutting	..	..	..	..	..	..	..	..	..	..	..	..	4.4	..
185	Subsoil of S 184	..	..	..	..	..	..	..	..	..	..	..	..	5.9	..
<i>Tawa-Rumu Soils.</i>																
R 985	Railway cutting, Mamaku, 700 ft.	31	7.08	14.30	0.290	0.034	0.023	0.010	0.005	0.13	0.11	0.05	0.03	..	0.354	
S 988	Government scenic reserve, Mamaku	34	8.11	15.31	0.289	0.040	0.023	0.011	0.005	0.17	0.12	0.05	0.02	..	0.062	
60	Demonstration Farm, Mamaku	..	43.58	16.83	..	0.269	0.033	0.016	0.005	0.19	0.21	0.08	0.05	..	0.106	
59	Soil on rhyolitic neck..	..	40.88	15.41	0.402	0.108	0.020	0.012	0.007	0.26	0.14	0.01	0.03	..	0.050	
211	Rhyolitic country rock, Mamaku	..	13.86	1.97	0.052	0.034	0.018	0.020	0.001	0.08	0.08	0.30	0.02	..	0.007	
181	Demonstration Farm, Mamaku	..	..	..	..	..	..	..	..	..	..	..	..	5.6	0.072
183	Demonstration Farm, Mamaku; windmill paddock	..	..	..	..	..	..	..	..	..	..	..	..	5.5	..
182	Government scenic reserve, Mamaku forest	..	..	..	..	..	..	..	..	..	..	..	..	4.6	0.057
192	Mamaku forest	..	..	..	..	..	..	..	..	..	..	..	..	5.0	..

Results of pH determinations of soil and subsoils:—
R 1123/4/5: pH = 4.8, 5.7, 6.2 (rimu-tawa). Oturoa type.
R 1126/7/8: pH = 4.8, 5.7, 6.2 (birch). Oturoa type.
R 1156/7: pH = 4.8, 5.5 (birch).

crosses the Patetere Plateau. Trees of the red-birch measuring 48 ft. in girth have been met with in this area. Other trees, small trees, shrubs, and herbs common in this forest are *Metrosideros robusta* (rata), *Podocarpus ferrugineus* (miro), *P. spicata* (matai), *Dacrydium cupressinum* (rimu), *Weinmannia racemosa* (tawhero), *Ixerba*, *Beilschmiedia tawa*, *Quintinia serrata*, *Myrsine salicina*, *Panax Edgerleyi*, *P. arboreum*, *Elaeocarpus dentatus*, and *Griselinia littoralis*.

Shrubs: *Alseuosmia grandifolia*, *Coprosma lucida*, *C. robusta*, *Leucopogon fasciculatum*, *Melicytus lanceolatus*, *Olearia Cunninghamii*, *Panax anomalum*, *Senecio Kirkii*.

Ferns and herbs: *Astelia nervosa*, *Asplenium bulbiferum*, *A. falcatum*, *Cyathea medullaris*, *Dianella intermedia*, *Gleichenia dicarpa*, *Gahnia pauciflora*, *G. xanthocarpa*, *Hemitelia*, *Hymenophyllum*, *Lomaria discolor*, *Lindsaya trichomanoides*, *Microlaena avenacea*, *Pteris esculenta*, *P. scaberula*, *P. incisa*, *Polypodium Billardieri*, *Trichomanes reniforme*.

CONCLUSIONS.

The chemical analyses of these soils show that both the sandy silts and sandy loams are deficient in available and total phosphoric acid. The amount of iron in the sandy silts extracted by Dyer's 1-per-cent. citric-acid method also shows a deficiency compared with what one finds in ordinary soils. The amount of iron in the sandy loams (birch forest) is from two to four times the quantity found in the sandy silts (rimu-tawa forest).

Although outside the area of which this article treats, two analyses are included showing the composition of the Tirau paddock soil for comparison, as it is in this paddock, which is situated on two river-terraces, that bush-sick stock always recover. It is interesting to note, after making a correction for its higher water content, that the greater part of this paddock consists of soil which bears a very close resemblance, in the mechanical composition, to the birch-forest soils. This and the high amount of "available iron" in the soil naturally suggest that when these lands are cleared and grassed they may be found to be free from bush sickness or iron starvation. Settlers occupying lands along the Oturoa Road are said not to be troubled with this disorder in stock.

The correlation of the quality of the soil with the vegetation growing upon it is a most interesting fact, and requires investigation in the case of other pumice lands.

The chemical analyses were performed under the writer's supervision by Mr. L. D. Foster, Analyst, and the mechanical analyses by Mr. R. E. Grimmett, M Sc., Analyst.

Noxious Weeds Orders.—The plant woolly nightshade (*Solanum auriculatum*) has been added to the Third Schedule of the Noxious Weeds Act. The Cheviot County Council has declared broom and gorse to be noxious weeds within that County. The Waitomo County Council has declared Californian thistle *not* to be a noxious weed within its district.

THE HUTZELMAN TREATMENT OF FOUL-BROOD IN BEES.

J. A. CAMPBELL, Director of the Horticulture Division.

VERY considerable interest among beekeepers in New Zealand as well as in the United States has been created by what is known as the Hutzelman treatment of foul-brood infected combs. In the latter country the treatment, which consists of the immersion of the infected combs in a solution of alcohol and formalin, has, according to the journal *Gleanings in Bee Culture* and other publications, been largely practised both experimentally and commercially. By this means, if successful, large numbers of combs which hitherto have had to be melted down may be saved, thereby making possible a considerable economy in apiary practice.

The Department of Agriculture has naturally been appealed to for assistance in introducing the practice into this country. Action by the Department has been taken along the lines of instituting experiments; of arranging with the Customs Department a scheme whereby the materials necessary are made available to beekeepers for use if they so desire at a minimum of difficulty and expense; and in endeavouring to seek, through the United States Department of Agriculture, full details of the treatment and confirmatory information as to its efficiency, &c.

A reply to hand from the Bureau of Entomology of the United States Department, although it may be considered generally favourable, suggests caution in recommending further experimental work before a definitely favourable pronouncement can be given. The letter reads as follows:—

Your letter of 26th August, addressed to the Secretary of Agriculture, has been forwarded to this Bureau for reply. The investigation which this Bureau is making on the disinfecting of American foul-brood combs by the use of a formaldehyde-alcohol solution is not yet completed, and no definite statement can be made. We have only recently had opportunity to begin work on this in the apiary, and cannot report on it until next season.

The consensus of opinion of many who have used this process commercially during the season is favourable, only a few reporting non-success, those who have been sterilizing combs in large numbers being most enthusiastic over its use. I believe that a summary of the season's practical results will soon be published in *Gleanings in Bee Culture*.

It would be a mistake, however, if beekeepers should allow themselves to be satisfied with the treatment as it has been worked out. A cheaper and more convenient solution or method for disinfecting combs is much desired in this country, as alcohol is expensive, as well as difficult, for the small beekeeper to secure.

Our information is to the effect that the solution should consist of 20 per cent. formalin and 80 per cent. alcohol. It is advised that grain alcohol and not the ordinary denatured alcohol or wood-alcohol be used.

As soon as we have any suitable data, publicity will be given to them through the bee journals.

SUGAR-BEET TRIALS IN CANTERBURY, SEASON 1923-24.

F. E. WARD, Instructor in Agriculture, Christchurch.

FOR several years past there has been a movement in Canterbury for establishment of the beet-sugar industry. Nothing tangible has yet eventuated regarding the erection of a factory, but small areas of beets have been grown, mainly with the object of demonstrating the suitability of soil and climate. The Department of Agriculture has from time to time imported seed for trial purposes. The last consignment of the variety Wanzelban was received from Australia in the late spring of 1923. As the movement centred chiefly in the Ashburton district last year, a number of plots were tried there as well as in the Kaiapoi district, where the most serious attempts at the establishment of the industry had been made.

Reports have recently been received from growers, and certain crops have been inspected and weighed by officers of the Department. The reports as a whole have indicated an unsatisfactory crop, due almost entirely to the late arrival of the seed and the extreme dryness of the season. The seed was not sown until November, and the rainfall for the ten months from November to August, 1923-24, inclusive, was only 15.79 in. at Ashburton and 16.98 in. at Christchurch. The yield from two farms in the Ashburton district which were above the average was as follows :—

Mr. Harry Brown, Wakanui : Wanzelban variety, sown in November, 1923, at 13 lb. per acre ; width of drills, 28 in. ; manures various ; average yield of topped beets from five plots, 6 tons per acre.

Ashburton Experimental Farm : The following results were obtained from plots receiving different treatments in regard to width of row, manures, &c., the date of sowing being 8th November, 1923 :—

Width of Rows.	Manure.	Plants thinned to	Yield per Acre.
Inches.			Tons.
18	300 lb. super	8 in. apart	11.85
18	No manure	8 in. apart	8.85
18	300 lb. super	1 ft. apart	10.26
28	280 lb. super	1 ft. apart	9.75
28	No manure	1 ft. apart	7.43
28	300 lb. mangold-manure ..	1 ft. apart	7.86

The average yield of four manured plots was equal to 9.93 tons per acre of topped beets.

It seems evident from the observations of this and other seasons that sugar-beet can be sown in closer rows than mangolds. The latter

is usually sown on the ridge in 26 in. or 28 in. rows, while beet should be on the flat in 18 in. or 21 in. drills. The rates of sowing appear to vary considerably in the various sugar-beet-growing countries of the world, and all seem higher than the requirements in New Zealand. From the evidence obtained up to the present, with good seed and favourable conditions, 8 lb. to 10 lb. per acre, in 18 in. or 21 in. drills, should be an ample sowing.



SAMPLES OF SUGAR-BEET GROWN BY MR. H. MCINTOSH, KAIAPOI.

Seed drilled 20/11/23. Photo taken 26/6/24. Scale indicated by foot rule.

A *variety trial* conducted on the farm of Mr. Hector McIntosh, Kaiapoi, indicated the unsuitability of certain varieties, not from the point of low yield, but from the fact that too large a portion of the beets grew above ground, making them unsuited to sugar-manufacture. The varieties tried were: (1) Wibolth's Danish Improved, (2) Wanzelban, (3) Rose Giant, (4) White Giant. The two first-named varieties were shown to be of suitable type, and the others proved to be unsuitable.

Island Phosphates.—The Department's Chemist, in his last annual report, records the discovery by Mr. F. W. Furkert, Public Works Department, of a deposit of phosphate of aluminium at the Three Kings Islands. Samples contained from 14.81 to 31.55 per cent. of phosphoric anhydride, but no calcium was present. From White Island the Chemist also received a sample of guano containing 1.4 per cent. nitrogen and 7.13 per cent. phosphoric anhydride. This would be worth £2 to £3 per ton after grinding. Both of these island phosphates were evidently derived from bird-dung.

TESTING OF PUREBRED DAIRY COWS.

OCTOBER CERTIFICATE-OF-RECORD LIST.

W. M. SINGLETON, Director of the Dairy Division.

At this season of the year certificates are being issued in large numbers, and the present list contains particulars for 189 cows and heifers. Not only is the list strong numerically, but many good performances are recorded.

Lulala, a junior two-year-old Jersey, with 678.17 lb. butterfat, falls only some 12 lb. below the leader of her class, Alfalfa Pansy. The first three names in the senior two-year-old Jerseys show butterfat yields exceeding 600 lb., and the first four three-year-olds of the same breed have each produced beyond the 700 lb. mark.

In the Friesians appear, among others, Mutual Stella de Kol, a senior two-year-old, with a certificate for 720.43 lb., and Rosevale Catrina Posch, a junior three-year-old, with 679.48 lb.

The outstanding features of the list, however, are the performances of the three-year-old Jersey, Loo's Queen, with 797.32 lb. butterfat, and the senior four-year-old Milking Shorthorn, Matangi May 2nd, with 574.56 lb. Each of these cows has now gained a class-leadership.

Loo's Queen was bred and tested by Mr. A. Christie, Tanekaha, the breeder and owner of Vivandiere, the champion of the breed. The previous leader of the class was Mr. E. Joyce's Zola of Rosy Creek, who gained a certificate of record for 741.20 lb. butterfat, so that Loo's Queen has exceeded this performance by 56.12 lb. Loo's Queen and Vivandiere are half-sisters, Loo being the dam in each case. The sire of Loo's Queen is Jersey Brae's Sea Lord, who on the sire's side goes back three generations to K.C.B., and on the dam's side three generations to Majesty's Fox, which names require no further comment. Well-known females on this side of the pedigree are Avalanche (Fitzwilliam-Snowdrift) and Eileen (Imp.). Loo (dam of Loo's Queen) is by Roberts (Imp.), a well-known Jersey sire, and two generations farther back on the female side K.C.B. appears twice. It would thus appear that the earlier importations into the Dominion are still adding to their reputation for quality and prepotency.

Matangi May 2nd was bred and is owned by Messrs. Ranstead Bros., of Matangi, and her yield of 574.56 lb. butterfat exceeds that of the previous leader, Mr. R. S. Allan's Sweet Garnett 2nd of Cornwall Park, by 60.37 lb. Messrs. Ranstead Bros. now have the enviable distinction of holding six leaderships out of the seven classes into which the Milking Shorthorn breed is subdivided. Matangi May 2nd is sired by Dominion Esau of Ruakura, so that with the exception of Maniaroa Princess the champions from Messrs. Ranstead Bros' farm are all daughters of this bull. The dam of Matangi May 2nd is Matangi Mary, who as a mature cow gained a certificate for 630.49 lb. butterfat.

LIST OF RECORDS.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS.						
		Yrs.	dys.	lb.	lb.	lb.
<i>Junior Two-year-old.</i>						
Lulala ..	R. Dunn, Auroa ..	2	2	240.7	365	10,210.5
Penrose Gale ..	J. B. Clemow, Stratford ..	2	11	241.6	365	9,008.7
Carhuduff Golden Lily	J. O'Donnell, Bunnythorpe	1	300	240.5	365	10,468.5
Twylish Thistledown	W. T. Williams, Pukehou ..	1	349	240.5	365	10,399.6
Wahinepai's Creamy†	E. Joyce, Kaponga ..	1	342	240.5	365	10,583.0
Olive's Darling ..	E. Joyce, Kaponga ..	1	347	240.5	365	10,492.8
Phalaena ..	A. H. Elicott, Hamilton N.	2	27	213.2	365	9,200.5
Elf's La Primevere ..	J. Robb, Westmere ..	2	27	243.2	364	8,330.6
Jerseydale Vanity ..	J. Pettigrew, Pihama ..	1	345	240.5	365	6,759.9
Euretta ..	M. J. Price, Taonui ..	1	291	240.5	365	10,378.1
Llangollen Princess ..	J. T. Entwisle, Cambridge ..	2	36	244.1	365	8,331.0
Celia's Pride ..	E. Joyce, Kaponga ..	1	332	240.5	365	8,561.0
Lady Vance ..	F. J. Finer, Ngutuweru ..	1	349	240.5	365	9,862.6
Sunkist's Silver Bell ..	P. A. Anderson, Levin ..	2	22	242.7	362	9,166.7
Volec's Marigold ..	P. A. Anderson, Levin ..	2	40	244.5	365	8,001.4
Brentwood Treasure ..	C. A. Willis, Pukekohe ..	1	332	240.5	365	8,505.5
Penrose Princess Mary	J. B. Clemow, Stratford ..	1	347	240.5	365	7,618.8
Tiny Sweet ..	A. J. Harris, Bombay ..	1	323	240.5	365	7,218.3
Brooklyn Golden Diana	H. J. Lancaster, Glen Oroua	1	304	240.5	365	7,800.2
Llangollen Lady ..	J. T. Entwisle, Cambridge	2	15	240.5	365	9,184.6
Oakvale Dixie ..	J. H. Street, Bell Block ..	2	9	241.4	365	8,159.8
Mune's Hope ..	P. A. Anderson, Levin ..	1	359	240.5	363	8,344.5
Thornycroft Princess	T. M. Remington, Westmere	2	18	241.3	365	6,614.5
Cairnhill May Queen	Richmond Bros., Stratford	1	321	240.5	365	8,136.7
Gold Plane ..	A. Christie, Tanekaha ..	1	268	240.5	365	9,143.7
Ohio Bilberry's Eminence	A. H. Guy, Mangatoki ..	1	303	240.5	365	8,787.5
Ohio Nettie ..	A. H. Guy, Mangatoki ..	2	34	243.9	365	8,447.0
Westmere Joyce ..	J. Robb, Westmere ..	2	33	243.8	365	7,593.5
Kuranui Myosotis ..	O. Glynn, Morrinsville ..	1	358	240.5	365	7,420.5
Arthingworth Renata	E. Smallbone, Richmond ..	1	341	240.5	365	7,702.6
Springburn Volee ..	R. L. Horn, jun., Ohau ..	1	322	240.5	365	8,308.2
Neat Lassie ..	F. J. B. Ryburn, Paterangi	1	349	240.5	364	8,108.1
Waimarie Dulcie ..	H. J. Livingston, Kiwitea	1	341	240.5	365	7,675.7
Uruti Topsy ..	W. Oxenham, Uruti ..	1	349	240.5	365	7,952.5
Lamorna Lass ..	S. A. Tippet, Okaiawa ..	1	322	240.5	365	7,156.7
Thornycroft Beauty ..	T. M. Remington, Westmere	2	31	243.6	360	6,840.1
Brentwood Favourite	C. A. Willis, Pukekohe ..	1	357	240.5	365	6,179.0
Maori Rowdy Girl ..	R. C. Powell, Bunnythorpe	1	356	240.5	355	7,009.3
Lovely Eyes ..	R. Hicks, Hawera ..	2	48	245.3	326	7,769.5
Dudu's Farewell ..	G. R. and H. Hutchinson, Auckland	1	318	240.5	365	7,284.3
Jersey Meadow's Dorothy	P. A. Anderson, Levin ..	2	3	240.8	365	8,664.8
Quillet ..	J. J. Scheuber, Hawera ..	1	310	240.5	365	8,681.1
Abberly Sybil ..	T. Ranford, Palmerston N.	1	364	240.5	365	7,744.0
Golden Maiden ..	H. J. Lancaster, Glen Oroua	2	18	242.3	365	7,029.3
Duke's Empress ..	A. C. Sorensen, Eltham ..	1	320	240.5	326	5,921.3
Pine Bank Ruby ..	J. Meuli, Normanby ..	2	10	241.5	353	6,422.8
Middlewood Darling	H. Beaton, Aorangi ..	2	12	241.7	365	7,115.0
Middlewood Ruby ..	H. E. Williams, Tokomaru	2	22	242.7	365	6,986.2
Hillview Hazel ..	Hunter Bros., Te Kowhai ..	1	309	240.5	342	7,967.8
Fleurou ..	Aickin and McCarroll, Woodhill	1	321	240.5	365	5,871.3
Burnside Queen Bessie	S. J. Holland, Rowan ..	2	17	242.2	309	6,861.0

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cent.	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS—continued.

<i>Junior Two-year-old—continued.</i>		Yrs. dys.	lb.		lb.	lb.
Briarbank Alma K.C.	R. D. Dagg, Kaponga ..	2 15	242.0	352	5,424.5	342.62
Middlewood Jean ..	E. E. Hale, Hamilton ..	1 328	240.5	343	5,568.4	340.45
Chase's Supreme ..	F. P. King, Cambridge ..	1 318	240.5	365	6,059.2	335.11
Mayflower of Bull's ..	F. J. Watson, Bull's ..	2 45	245.0	350	5,381.7	330.97
Holly Bank Lass ..	John Nicolson, Hawera ..	1 338	240.5	300	5,950.5	328.74
Tirohia Silver Spray ..	B. E. Veale, Tirohia ..	1 349	240.5	328	7,401.7	318.76
Meadowvale Miss Jellicoe	C. Meuli, Tariki ..	2 9	241.4	362	5,874.8	316.90
Hillview Famous ..	Aickin and McCarroll, Woodhill	1 317	240.5	365	6,006.6	303.77
Airton Victorine ..	W. H. Waterhouse, Runciman	2 7	241.2	350	5,211.1	296.66
Ferndale Golden Fern	C. Meuli, Tariki ..	2 2	240.7	345	4,717.9	292.83
Huabrook Dovelet ..	W. H. Waterhouse, Runciman	2 18	242.3	313	4,859.6	278.10
Cloverlea Avalanche ..	R. J. Morris, Opunake ..	2 18	242.3	289	5,137.5	266.21
Parakau Lulu ..	Aickin and McCarroll, Woodhill	2 21	242.6	284	5,114.7	255.66
Pencarrow's Twylish Charm	A. W. Foulds, Kumeu ..	2 15	242.0	247	4,552.4	251.45
<i>Senior Two-year-old.</i>						
Abberly Stella ..	J. O'Donnell, Bunnythorpe	2 359	276.4	365	10,690.5	656.70
Kuku Glory ..	R. L. Horn, sen., Ohau ..	2 329	273.4	365	12,059.9	633.69
Holly Oak Adeline* ..	W. T. Williams, Pukehou ..	2 334	273.9	365	11,115.0	614.74
Penrose Maid ..	J. B. Clemow, Stratford ..	2 337	274.2	365	9,280.0	579.05
Rockview Lady ..	G. R. and H. Hutchinson, Auckland	2 358	276.3	365	10,161.5	541.83
Penrose Duchess ..	J. B. Clemow, Stratford ..	2 319	272.4	365	8,453.9	506.83
Briar Bank Holly ..	R. D. Dagg, Kaponga ..	2 363	276.8	349	8,326.0	505.45
Lambert's Mollie ..	John Nicolson, Hawera ..	2 347	275.2	357	7,934.5	502.80
Cloverlea Maid ..	D. P. F. Malone, Kaponga ..	2 298	270.3	365	8,266.0	499.53
Ethel's Hope ..	J. McIvor, Ohau ..	2 355	276.0	365	8,343.2	498.67
Almadale Silvie ..	Hunter Bros, Te Kowhai ..	2 325	273.0	365	9,213.0	473.64
Trethella Silver Stream	R. L. Horn, jun., Ohau ..	2 306	271.1	365	8,931.3	471.90
Loyalty's Jem ..	W. E. Wickham, Waitara ..	2 359	276.4	365	8,390.0	466.21
Some Girl ..	J. E. Rae, Taneatua ..	2 349	275.4	327	8,324.0	438.93
Makanui Duchess ..	H. G. Livingstone, Kiwitea	2 330	273.5	365	6,262.8	420.40
Noble Gray Girl ..	Robert Wattam, Fencourt ..	2 353	275.7	355	7,052.5	400.53
Holly Oak Dewdrop ..	A. C. Sorensen, Eltham ..	2 298	270.3	330	6,361.9	356.95
Reward's Hope ..	J. McIvor, Ohau ..	2 338	274.3	332	6,471.2	301.67
Springbank Pet ..	E. S. Holdaway, Ballance ..	2 280	268.5	282	4,823.8	272.43
<i>Three-year-old.</i>						
Loo's Queen ..	A. Christie, Tanekaha ..	3 332	310.2	365	13,422.3	797.32
Trethella Sunlight ..	J. D. Brown, Weraroa ..	3 3	277.3	365	13,726.4	733.29
Indara* ..	F. J. Finer, Ngutuware ..	3 350	312.0	365	12,849.0	724.68
Kuku Delightful ..	R. L. Horn, sen., Ohau ..	3 315	308.5	365	12,780.3	715.21
Jersey Meadows Regna	H. H. Phillips, Te Rehunga	3 351	312.1	365	10,455.7	631.62
Kuku Spot ..	R. L. Horn, sen., Ohau ..	3 345	311.5	365	11,720.1	629.50
Melita ..	J. Nicolson, Hawera ..	3 322	309.2	365	11,959.5	584.66
Zaida ..	H. O. Washbourn, Richmond	3 311	308.1	365	11,427.9	571.17
Waitapu Lassie ..	E. Sinclair, Waitapu ..	3 222	299.2	365	11,075.8	555.46
Lady Jose ..	J. J. Scheuber, Hawera ..	3 339	310.9	365	10,675.8	524.39
Shamrock's Tiny ..	E. Bennett, Cardiff ..	3 322	309.2	338	8,059.1	508.25
Rosy Creek Song ..	D. P. F. Malone, Kaponga	3 363	313.3	365	11,040.2	507.61
Jersey Oak's Uni's Lady	G. Milligan, Mangateretere ..	3 7	277.7	326	8,656.5	496.33
Jersey Meadows Ivy	H. H. Phillips, Te Rehunga	3 328	309.8	365	8,439.3	485.28
Primrose Jolie ..	A. Buchanan, Palmerston N.	3 49	281.9	365	9,050.2	481.86

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cent.	Yield for Season.		
				Days.	Milk.	Fat.

JERSEYS—continued.

<i>Three-year-old—continued.</i>						
Kahuwera's Rose ..	J. V. Mortensen, Piopio ..	3 357	312·7	365	9,224·9	451·85
Passion's Beauty ..	J. Robb, Westmere ..	3 342	311·2	365	9,663·0	449·01
Lupin's Beauty ..	G. Milligan, Mangateretere ..	3 317	308·7	349	9,904·9	446·64
Radiant Sunset ..	G. R. and H. Hutchinson, Auckland ..	3 31	280·1	327	7,210·1	430·25
Fair View Magnet ..	H. Mellow, Kaponga ..	3 20	279·0	294	7,200·7	422·97
Almadale Gem ..	Hunter Bros., Te Kowhai ..	3 23	279·3	332	6,571·7	414·53
Brookley Dairymaid ..	W. Johnson, Ngaere ..	3 10	278·0	259	5,333·8	313·85
Blossom's Hope ..	C. Meuli, Tariki ..	3 203	306·3	359	5,449·9	313·42
<i>Four-year-old.</i>						
Penrose Princess ..	J. B. Clemow, Stratford ..	4 10	314·5	365	10,867·5	619·15
Algoma ..	R. Waterhouse, Papakura ..	4 66	320·1	320	9,555·5	541·48
Armistice K.C. ..	R. D. Dagg, Kaponga ..	4 288	342·3	365	8,971·0	483·75
Illawarra's Floss ..	R. J. Morris, Opunake ..	4 326	346·1	365	8,916·0	160·55
Balla Mona Koi ..	J. Hunt, Richmond ..	4 295	343·0	365	8,261·8	456·45
Belvedere Laurel ..	E. B. Eagle, Greytown ..	4 28	316·3	286	8,203·0	425·21
<i>Mature.</i>						
Kairanga Lady ..	L. A. Lancaster, Kopane ..	6 51	350·0	365	9,969·7	670·66
Utility ..	J. O'Donnell, Bunnythorpe ..	9 323	350·0	365	11,371·8	656·29
Brixton's Queen ..	A. J. Luxton, Omata ..	8 7	350·0	365	11,441·2	622·69
Thistle Chase ..	A. J. Dempsey, Horsham Downs ..	7 218	350·0	365	10,016·3	607·43
Kuku's Princess ..	R. L. Horn, sen., Ohau ..	5 302	350·0	365	12,048·7	605·58
Jersey Brae's French Girl ..	J. T. Entwisle, Cambridge ..	5 284	350·0	365	10,044·4	604·65
Crofton's Dolly ..	A. J. Luxton, Omata ..	5 2	350·0	365	11,243·7	590·43
Abbess ..	A. H. Guy, Mangatoki ..	7 332	350·0	310	9,122·9	555·06
Jersey Lea Model Lily ..	S. Bowker, Ihakara ..	7 311	350·0	365	9,381·5	552·65
Willowbank Ability ..	W. Johnson, Ngaere ..	5 363	350·0	360	10,413·1	550·31
Rozel's Cowslip ..	J. B. Clemow, Stratford ..	5 329	350·0	365	10,368·0	549·71
Village Maiden ..	J. Klenner, Kaimata ..	6 3	350·0	361	10,323·5	544·18
Lassy's Daisy ..	Keightley Bros., Waitoa ..	5 298	350·0	365	10,047·1	533·86
Reid Park's Queen Bess ..	C. A. Willis, Pukekohe ..	5 326	350·0	365	10,379·8	520·92
Pick of the Bunch ..	H. H. Buxton, Auroa ..	8 341	350·0	352	11,848·5	524·50
Doris of Bull's ..	M. J. Price, Taonui ..	7 62	350·0	365	10,805·6	517·44
Kilkenny ..	B. G. Doel, Taumarere ..	10 280	350·0	365	10,004·4	507·63
Holly Bloom ..	T. M. Remington, Westmere ..	10 359	350·0	365	8,711·3	501·27
Polly Hinemoa ..	F. P. King, Hautapu ..	7 24	350·0	365	10,192·4	497·63
Holly Bank Bell ..	H. H. Buxton, Auroa ..	9 354	350·0	347	9,520·9	497·60
Sunny's Darling ..	J. Karl, Paterangi ..	5 208	350·0	365	7,576·7	487·29
Hawkesbury Grace ..	C. A. Willis, Pukekohe ..	7 305	350·0	365	8,889·4	486·36
Eminent Rosebud ..	F. P. King, Hautapu ..	5 23	350·0	365	8,828·2	477·05
Rewa Mone ..	P. A. Anderson, Levin ..	6 29	350·0	337	9,000·1	452·40
Grafton Sunset ..	Brakenridge and Pearson, Taupaki ..	5 287	350·0	365	9,073·3	449·99
Caloola Thistle ..	H. H. Buxton, Auroa ..	6 25	350·0	321	8,358·0	435·48
Awatea ..	M. J. Price, Taonui ..	6 215	350·0	303	7,832·8	427·90
Little Charm ..	H. H. Buxton, Auroa ..	8 304	350·0	317	8,872·8	425·75
Queen Soumise ..	A. Thorne, Levin ..	8 12	350·0	365	7,980·4	404·44
Neptune's Daughter ..	C. Meuli, Tariki ..	5 9	350·0	340	6,972·1	367·86
Mauriaena Veronica ..	Aickin and McCarroll, Woodhill ..	5 316	350·0	301	7,251·2	367·18
Burnside's Lassie ..	S. J. Hollard, Rowan ..	5 293	350·0	300	6,256·5	361·49

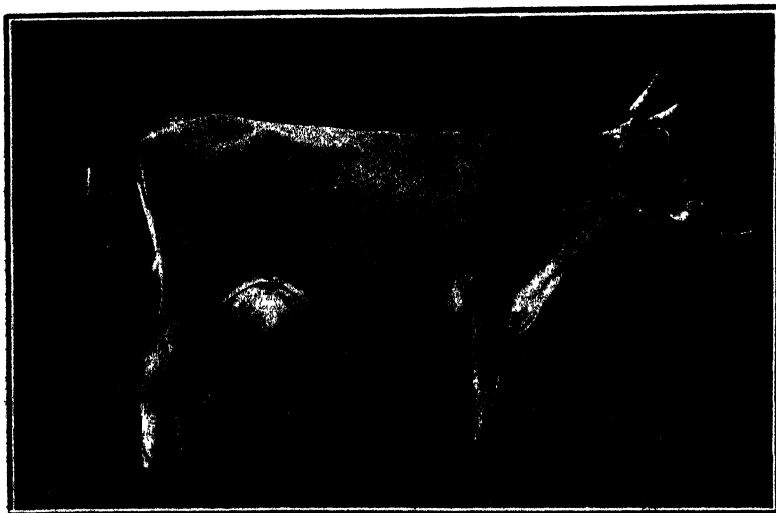
LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.

FRIESIANS.						
		Yrs. dys.	lb.		lb.	lb.
<i>Junior Two-year-old.</i>						
Rosevale Sylvia Model Keyes*	T. Sherriff, Clandeboye ..	2 160	256·5	365	17,765·7	612·27
Glen Iris Queen Segis*	R. R. Pearson, Rongotea ..	2 35	244·0	365	15,400·5	517·11
Cluny Pietje Kate 11th†	Piri Land Company, Orini..	2 88	249·3	316	9,312·0	309·68
Pretty Maid Alcartra†	S. Andrew, Kaikoura ..	2 8	241·3	365	8,947·4	289·15
Murihiku Topsy† ..	Gibb Bros., Clifton ..	2 26	243·1	294	7,449·0	278·42
<i>Senior Two-year-old.</i>						
Mutual Stella De Kol*	C. R. Duncan and Sons, Whangamarino ..	2 338	274·3	365	16,624·8	720·43
Colinton Clover Omega*	R. Colee, Greendale ..	2 343	274·8	365	16,461·5	601·30
Mutual Lass of Longview†	C. R. Duncan and Sons, Whangamarino ..	2 320	272·5	365	15,371·5	591·07
Ryvington Dorothea*	Hodgson Estate, Tamahere ..	2 349	275·4	365	14,864·3	558·22
Ryvington Lulu† ..	Hodgson Estate, Tamahere ..	2 324	272·9	365	15,747·4	557·21
Parcora Ethel Korn-dyke*	A. S. Elworthy, Timaru ..	2 324	272·9	365	1,677·9	514·34
Parcora Cherry Blossom*	A. S. Elworthy, Timaru ..	2 324	272·9	365	14,130·5	491·35
Rosevale Helena Keyes*	McDonald and Co., Dunedin ..	2 264	266·9	365	15,453·3	471·10
Cluny Hengerveld Rosebud 4th*	Matangi Friesian Farm Com-pany, Matangi ..	2 236	264·1	365	10,864·0	386·36
Ashlynn 11th* ..	E. F. Peacocke, Hamilton ..	2 296	270·1	365	9,423·5	332·53
<i>Junior Three-year-old.</i>						
Rosevale Catrina Posch*	H. North and Sons, Omimi ..	3 88	285·8	365	21,688·2	679·48
Glen Iris Patchwork*	R. R. Pearson, Rongotea ..	3 25	279·5	365	18,351·0	588·55
Princess 2nd of Fairburn†	F. Crump, Springston ..	3 4	277·4	365	15,440·6	481·28
<i>Senior Three-year-old.</i>						
Te Repo Bounty Girl*	R. Colee, Greendale ..	3 189	295·9	365	14,377·6	574·82
Princess Korndyke†..	W. J. Eames, Livingstone ..	3 191	296·1	365	13,612·5	465·07
<i>Junior Four-year-old.</i>						
Rosevale Sylvia Colantha*	H. North and Sons, Omimi ..	4 167	330·2	365	18,025·2	651·18
Weston Lea Challenge Soldene*	E. F. Peacocke, Hamilton ..	4 3	313·8	365	11,238·1	452·50
<i>Senior Four-year-old.</i>						
Lady Winana of Woodlyn*	T. C. Barbour, East Tamaki ..	4 363	349·8	365	17,696·7	527·15
<i>Mature.</i>						
Rosevale Nancy Posch*	H. North and Sons, Omimi..	5 147	350·0	365	20,563·3	664·98
Tinie Grant 2nd* ..	John Court, Ltd., Auckland ..	5 21	350·0	365	20,844·8	649·05
Lady St. Eloi* ..	C. R. Duncan and Sons, Whangamarino ..	7 193	350·0	365	16,356·2	578·48
Zozo 2nd of Ashlynn*	John Court, Ltd., Auckland ..	7 242	350·0	305	13,322·4	555·44
Princess Van Friesland Park	A. S. Elworthy, Timaru ..	5 298	350·0	365	16,274·6	553·09
Johanna Alcartra* ..	John Court, Ltd., Auckland ..	5 297	350·0	365	18,139·4	531·18
Weston Lea Belle* ..	E. F. Peacocke, Hamilton ..	6 28	350·0	365	13,339·3	448·77
Bainfield 27* ..	C. H. Potter, Pukerau ..	6 46	350·0	114	9,594·7	361·48
MILKING SHORTHORNS.						
<i>Senior Three-year-old.</i>						
Matangi Jewel 2nd† ..	Ranstead Bros., Matangi ..	3 362	313·2	365	12,480·4	561·57
Matangi Lily 3rd† ..	Ranstead Bros., Matangi ..	3 358	312·8	325	12,766·1	561·13

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
MILKING SHORTHORNS— <i>continued.</i>						
<i>Senior Four-year-old.</i>		<i>Yrs. dys.</i>	<i>lb.</i>		<i>lb.</i>	<i>lb.</i>
Matangi May 2nd* ..	Ranstead Bros., Matangi ..	4 3/4	349·9	365	13,640·8	574·56
<i>Mature.</i> ..	..				
Pukekite Rangit ..	R. King, Buckland ..	Mature	350·0	365	12,901·8	605·29
Eleam Ruth† ..	Hanson Bros., Parakai ..	8 3/4	350·0	331	12,169·0	458·42
Braeside Parisian Dia- mond†	Hanson Bros., Parakai ..	Mature	350·0	356	10,503·4	425·79
AYRSHIRES.						
<i>Two-year-old.</i>						
Jean 2nd of Carmel Glen†	A. W. Foulds, Kumeu ..	1 3/4	240·5	327	7,531·6	307·86
Belle of Earlstoun ..	R. Marshall, Runciman ..	2 4/4	244·9	365	6,329·8	289·81
Trixie of Carmel Glen†	A. W. Foulds, Kumeu ..	1 3/4	240·5	363	6,350·0	259·86
Joan of Earlstoun ..	R. Marshall, Runciman ..	2 3/4	244·1	358	6,146·5	258·68
<i>Three-year-old.</i>						
Isobel of Ashleigh Park†	C. B. Morgan, Ngawapuria	3 2/4	306·0	365	12,463·2	528·47
Second-class Certificates.						
JERSEYS.						
<i>Three-year-old.</i>						
Maori Pulchra ..	A. G. Somervell, Takapau	3 2/5	306·5	365	8,255·9	519·29
FRIESIANS.						
<i>Junior Four-year-old.</i>						
Friesland Model Maid*	A. S. Elworthy, Timaru ..	4 1/2	328·7	365	13,668·5	394·76



OAKLAND'S GUERNSEY (F. W. CORNWALL, BELL BLOCK).

C.O.R., 1923, in Jersey three-year-old class: 10,565·3 lb. milk, 692·54 lb. butterfat.

SEASONAL NOTES.

THE FARM.

HAYMAKING.

In December haymaking will become general. Meadow hay should be cut when the predominant varieties of grasses are in flower—that is, technically expressed, when the anthers are protruding from between the chaff-scales. The weight of herbage and the digestible nutrients will then be at about their maximum. The distribution of the nutrient material is also fairly uniform, whereas at a later stage a transference of much of this material to the developing seeds takes place, and the stem becomes fibrous and indigestible. A little loss in weight owing to an early start is generally more than counterbalanced by the superior feeding-qualities of the crop. Moreover, the earlier the crop can be removed the better the aftermath. Hay should not be allowed to get too dry before being raked into rows or put up in cocks. Gradual drying is much to be preferred to baking, which is likely to ensue if the crop is left spread over the ground during very hot weather.

Many farmers experience difficulty in saving lucerne, tare, or clover hay in good condition. All legumes require more "making" than do the grasses, and suffer more from the wetting, drying, and handling that prolonged haymaking in a changeable climate entails. A good practice is to gather the hay into big cocks when it is still half made, generally on the second day after cutting. These cocks should be about a couple of dray-loads in size, and must be carefully built and raked down so as to turn any rain. In them the hay will sweat considerably, but, being comparatively small in volume, little harm will result. They may be left standing, if necessary, for several weeks, but are usually fit to stack by the end of ten days. They may be drawn to the stack by a chain passed round them, but care must then be taken that any stones and dirt are shaken out of the bottom layer before it is pitched up to the stack. A slower but rather better method is to load them on to drays.

In the case of cereals intended for hay, the best stage for cutting is when the straw is still green and the grain is just getting into the dough stage.

ENSILAGE.

Ensilage should have more recognition in this country as a valuable stand-by in case of the failure of root crops, green fodders, or pastures. It can be readily made from surplus grass, lucerne, cereals, and tares or peas, &c., especially when weather conditions are against haymaking. For the stack method a site with good drainage should be selected, and sufficient material cut and carted to build 6 ft. or 8 ft. the first day. This should be allowed to stand until it attains a temperature of at least 130°, but at no time more than 150° F. The building-up of more material is then continued from time to time, as heat is generated in each successive layer. After the first layer it should be only a few feet, until completion of the stack, which may be eventually about 18 ft. or 20 ft. high. The stack should be as nearly square as possible,

and the smallest size not less than 14 ft. by 14 ft., which would provide about 40 tons of material. Salt at the rate of about 6 lb. per ton of green material should be used. When the last layer has reached the required temperature the stack is covered with soil about 18 in. thick, this preventing a further rise in temperature. The stack will settle down very considerably from day to day while being built. If a wind on one side should cause uneven settling, a tarpaulin can be hung on the weather side. The sides should be kept as tight as possible in building, and perpendicular, and the heart level or slightly below the outer tiers. From 40 lb. to 45 lb. of ensilage is a sufficient daily ration for an average cow, and a cubic foot of the material weighs from 40 lb. to 50 lb. according to quality.

ROOT CROPS.

In most districts swedes may be sown during the whole of December, and the best results are often obtained from sowings in the last week of the month. Further sowings of soft turnips for cow-feeding and lamb-fattening should be made. Hardy or Imperial Green Globe are among the best for cows, and are also excellent for lamb-fattening. For later feeding for hoggets, and to take the place of swedes, Green-top Aberdeen (or "Green-top Scotch," as they are frequently called) are very suitable.

Early-sown mangold crops will now be ready for thinning and intercultivation, and careful work will be amply repaid by increase in yield. From 9 in. to 12 in. apart is common for singling, but the Globe varieties generally require a little more space than the Long Reds or Tankards, and up to 15 in. apart will not be too great a distance for plants in good land. The earth should be drawn well away from the remaining plants. Where germination has been patchy it is usual to fill in the gaps by transplanting, and in such cases it is wise to mix a little fresh fertilizer with the soil. A dressing of 1 cwt. to 2 cwt. of nitrate of soda or sulphate of ammonia has in many cases been found to give excellent results if the crop is inclined to be backward and poor in colour. These fertilizers should be applied when conditions are damp.

Carrots will also require thinning--to about 6 in.--and intercultivation. Short varieties, such as the Guerande, which are principally grown for sheep-feed, are an exception as regards thinning, but the usual work with the horse-hoe is necessary.

POTATOES.

Main-crop varieties will require intercultivation and moulding. The maintenance of a soil mulch helps in the conservation of moisture, which normally becomes an important factor towards the end of the year.

In many districts potato varieties have become badly mixed. There are splendid foundation lines available to farmers in different parts, and an effort should be made to rogue fields so as to work into good pure lines. There have been extensive inquiries for pure lines during the spring.

GREEN FORAGES.

Sowings of rape may be continued for another month or two, especially where late lambs and old ewes require to be fattened.

Successional sowings of maize and millet for late summer and autumn feeding may be continued as detailed last month.

Winter forage crops, such as chou moellier and thousand-headed kale, are generally sown before the middle of December in the South. The fact that chou moellier will grow successfully on club-root-infected soil is of great importance. The seed should be ridged in, and eventually thinned out with either the hand- or horse-hoe. The land intended for such forage crops should be well worked, so as to encourage rapid growth.

SUMMER FALLOWING.

Under Canterbury conditions land that is being summer-fallowed with the object of weed-control should be kept stirred during the dry period generally experienced in midsummer. A successful fallow of twitch-infested land necessitates cultivation at sufficiently frequent intervals to prevent any appearance of greenness. As soon as the green leaves appear the plant commences to store food in the underground stems (commonly called "roots"), and it will use up this food reserve in its endeavour to get its green shoots above ground. On cultivated land Californian thistle has been eradicated successfully in one season by constant cutting off just below the ground with sharp broad-tined cultivators. When patches of the thistle are small a little care may save much expense and trouble later.

Old pasture paddocks may be ploughed up at this time of the year, worked thoroughly, and fallowed through the summer in preparation for the sowing of cereal crops in the autumn.

PASTURE-MANAGEMENT.

At the present time of flush pastures it is sound practice to confine stock as far as possible to limited areas, and to move them at frequent intervals as soon as they have grazed the paddock closely, rather than to allow large areas to be semi-grazed. The paddock should then be harrowed and shut up for a few days.

In the North *paspalum* pastures that show signs of getting ahead of the stock should be mown during December so that they may produce fresh feed for any dry spell in January and February.

—*Fields Division.*

THE ORCHARD.

VIGILANCE FOR BLACK-SPOT, ETC.

It is necessary to be always on the lookout at this season of the year for attacks of black-spot on apples and pears. The spray-pump should be kept in readiness for any emergency. Reports indicate that showery weather has been fairly general in most districts. Pasture land and root crops will benefit, but if these conditions continue fungus diseases of all kinds will be in evidence. Should showery weather continue it will be advisable not to move the soil by way of cultivation as this may bring any fungus-spores to the surface, and thereby cause severe infection which may do extensive damage before it is checked. It is much easier to prevent disease than to cure it.

Where brown-rot has been prevalent on stone-fruits in past seasons a careful watch should be kept for any appearance of it. The trees should be sprayed with lime-sulphur, 1-125, plus 4 lb. to 6 lb. of atomic or atomized sulphur.

If pear-slug makes its appearance on plums and cherries the trees should be sprayed with hellebore powder, using $\frac{1}{2}$ oz. per gallon of water. Some varieties of plums drop their fruit badly if sprayed with arsenate of lead.

MARKETING OF STONE-FRUITS.

The season is now approaching when the early varieties of stone-fruit will be reaching maturity. Every endeavour should be made to place fruit on the market in an attractive manner; appearance is becoming a more important factor each season. An honest pack, sound, evenly graded, well-coloured fruit, and clean, new, and neatly stencilled packages are all factors which attract the attention of buyers in these days. Quality also plays an important part and must not be overlooked. The desire to obtain high prices is a great temptation to place immature fruit on the market, but it is a practice that cannot be recommended, as owing to inferior quality it may eventually reflect adversely on prices obtaining later in the season. Fruit should be allowed to reach that stage of maturity when, after being consumed, it will create a further demand. The public is becoming more and more critical with reference to quality as well as appearance. All fruit does not mature and ripen together; therefore it is necessary to make several pickings. Choice peaches for dessert will always pay for being packed in trays and sent to the market in crates, buyers usually being very eager for this class of fruit.

REMOVING FRUIT FROM APPLE-LEADER GROWTH.

Some varieties of apples blossom freely on the young leaders, and where these blooms have set no time should be lost in removing the young fruit, otherwise it will greatly interfere with the leader-growth. For want of care in this respect much damage is often caused, and many trees become unsightly, and leaders weakened. The Jonathan is an example of this, and should be watched always for such weakness.

—*L. Paynter, Orchard Instructor, Christchurch.*

CITRUS-CULTURE.

The continuance of efficient cultivation in the groves, together with the spray applications as recommended in last month's notes, are the chief operations at the present time.

FIREBLIGHT.

During the coming month, and in particular the first half, is the period during which any infection by fireblight may be expected to take place. The necessity for prompt action on the part of orchardists in regard to this matter has previously been pointed out, and it is only necessary now to repeat the request that growers should immediately communicate with the nearest Orchard Instructor upon identification of suspicious symptoms on any trees in their district that come under their notice.

MARKETING OF SMALL-FRUITS.

The attention of strawberry-growers in particular is drawn to the regulations recently gazetted as to the packing of fruit, with a view

to bringing about a better state of affairs on the market in this regard than has hitherto been the case. The regulations were summarized in last month's *Journal* (page 288) for the information of growers of strawberries, loganberries, raspberries, and cherries generally. It is the intention of the Department to put these regulations into force immediately, and inspection of consignments coming forward to the market from time to time will be carried out henceforward.

—J. W. Collard, *Orchard Instructor, Auckland.*

POULTRY-KEEPING.

DISPOSING OF THE COCKERELS.

DECEMBER brings a busy time for the poultry-keeper, for, with the hatching season over, the housing and run accommodation will be taxed to the utmost. Not only this, but with the young birds gradually developing and demanding more space there is the risk of overcrowding and its consequent evil effects. To prevent this I would urge the necessity of feeding and managing all surplus cockerels to the best advantage, and marketing them immediately they attain the age of four and a half to five months. If cockerels are kept beyond this age they commence to produce their second feathers and thereby fail to put on flesh. If any money is to be made out of a cockerel it must be marketed in a prime condition before the second-feather period. The great point, however, in marketing early is that accommodation is saved, an effect which is distinctly in favour of the remaining stock, while more time is available to attend to the main function of the plant.

If cockerels are to put on a maximum of flesh in a minimum of time they must be separated from the pullets before they commence to crow. They should also have their exercise curtailed, as too much exercise is all against rapid flesh-production. It is also essential that they be housed in quarters that are free from vermin. It is a weak policy to try and prime cockerels on inferior or damaged foodstuffs. If the most profit is to be made from them the food supplied should be sound and fed with a free hand. A suitable morning mash may be made from two parts bran and one part each of finely ground wheat-meal and maize-meal, the whole being mixed with milk or soup into a crumbly mass. Feed three times a day as much as all the birds will eat up clean. Succulent green material should be fed in abundance but separately, and when skim-milk is available it may be given in large quantities to drink.

GREEN FOOD.

Every effort should now be made to provide an abundant supply of green material for autumn and winter use. In view of the present high cost of grain foods, the one and only way of reducing the food bill is to provide a considerable amount of green material in the daily ration. It not only means a saving of the more costly foods, but it also keeps the birds in a healthy thriving state, a condition which is imperative if the flocks are to produce to their fullest

capacity. Poultry-keepers with a patch of lucerne or clover established have a valuable asset in this respect. If these are cut during a succulent stage and finely chaffed they provide an excellent green food during the greater part of the year. In addition, when properly cured the dry chaff (when softened by steaming or boiling if fed by itself or mixed with the morning mash) will be relished by birds of all ages once they become accustomed to it. Silver-beet is another excellent thing to grow for poultry, and is a heavy cropper. Cabbage, kale, rape, and green oats may also be grown to advantage. I would again emphasize that for the young stock to prove really profitable layers they must never receive a setback, and one of the most common checks to healthy development is lack of green food during the growing stage.

TURKEYS.

Turkey-rearing can be made a profitable side line on farms where the conditions are favourable and the birds are properly managed. Turkeys do best on fairly high country that grows short tussock, grass, &c. On low-lying heavy damp ground it will generally be found a difficult matter to rear the young stock, especially where there is a heavy growth of grass. Having suitable soil and a generally favourable environment, the next important matter is to see that the breeding-stock possess strong constitutional vigour. This can be maintained only by frequent introductions of fresh blood, and by the birds being allowed to follow their natural instincts—living in the open and securing plenty of exercise and natural food. It is seldom or never that success is attained under confined conditions, nor will turkeys thrive when running with fowls or ducks.

A common mistake made in the management of turkeys is to use all members of the flock for breeding purposes. If a vigorous strain is to be built up and maintained none but the strongest specimens should be bred from. Before the breeding season arrives any small weak specimens of either sex should be weeded out. If these are bred from it means that the stock will become less vigorous each year. Constitutional vigour is undoubtedly the base on which the successful rearing of turkeys rests, and it must be maintained to the highest degree possible in order that they may have the power to resist the many troubles and diseases to which they are subject. It is necessary that a fresh male from an unrelated strain be introduced at least every third season. Turkeys do not mature till they are from two to three years old. It is therefore a mistake to breed from first-season birds, as these seldom or never produce vigorous progeny.

Turkey-eggs take about twenty-eight days to hatch, and usually fifteen to seventeen eggs are sufficient for the hen to brood properly. A good plan is to put six or seven eggs under an ordinary hen on the same day as the turkey is set, giving the whole to the turkey when hatched out. When setting a turkey use a large bottomless box; place this on the ground, and fill up for about 4 in. above ground-level with fine moist earth. This should be hollowed out in the centre, and made saucer-shaped. Fine hay, oat-straw, &c., are suitable for lining the nest. Care must be taken that the bottom of the nest is made more or less flat, so that the hen can turn the eggs without their rolling on top of each other and getting broken. On the seventh day the eggs should be tested for fertility and the infertile ones removed.

When the turkey hen commences to sit she should be disturbed as little as possible. It is a good plan to have food and water close by, so that she can come off to feed and drink when she pleases. One of the chief secrets in rearing young turkeys is to keep them free from vermin, and to guard against these the sitting turkey should be well dusted with insect-powder before she is set, and again before the pipping-stage. She should not be dusted when the chickens are very young, as the powder may get into their eyes and cause blindness.

After the chicks are hatched the hen and her brood should not be disturbed for at least twenty-four hours. They should then be placed in a large open-fronted, slatted, watertight coop that is free from draught. For the first two days both the hen and her chicks should be confined in the coop, and during the next week the mother should be kept confined, and the coop arranged in such a way that the young ones can have their liberty. In this way they will be encouraged to take exercise, an essential for their welfare. Where possible the coop should be placed on fresh, clean ground, as it is merely courting disaster to try and rear young turkeys on tainted soil. Some people tether the mother hen by the leg and remove her daily on to fresh ground. After ten days, providing the grass is not overlong and the weather is favourable, the hen and her brood can be given free range. Where there is long grass, and especially during wet weather or in the early morning when it is laden with dew, the amount of exercising-space should be curtailed, or the mortality will be great. The mother hen can be depended upon to protect her young during heavy rain, but if they are later trailed through long wet grass they mostly die.

Young turkeys commence to "shoot the red" when from eight to ten weeks old. This period is one of the most critical of their lives, and the only safe course to prevent losses is to provide natural conditions to the highest degree possible. At this stage the birds should be fed well away from the homestead in order to induce them to take a maximum amount of exercise. They should also be encouraged to perch, preferably in trees. It is a mistake to allow turkeys to sleep in houses, except perhaps in a high open-fronted shed. The average fowlhouse found on farms is nothing short of a death-trap where turkeys are concerned.

For the first few days after hatching the young birds should be given stale bread soaked in milk and then squeezed dry, in which some hard-boiled egg has been mixed. As a change they can have rice that has been boiled in milk. As the birds develop they may be given a mash made of finely ground wheat, bran, maize-meal, and oatmeal. The food must be mixed to a dry consistency. Young turkey chicks are always slow to take food, and it is a mistake to try and force them to eat. They have small crops, and require to be fed frequently, but only a little at a time. Overfeeding during the early stages is a common cause of bowel trouble and mortality. Clean water or milk should be given from the outset, and left before the birds at all times, while an ample supply of grit is essential for both old and young stock. Finely chopped green-stuff such as lettuce, young onions, or dandelion-leaves should be fed daily. Charcoal is also good for turkeys, and should be freely provided to birds of all ages.

—F. C. Brown, *Chief Poultry Instructor.*

THE APIARY.

NUCLEUS HIVES.

DURING the summer months every attention should be paid to raising a stock of young queens to replace old and failing ones. To buy new queens each successive season is too expensive, and with a little attention and care good queens can be raised by the beekeeper in his own yard. An apiary should be requeened each year, and queens should not be tolerated for more than two seasons at the most. In the long-run it is the queens that tell in the production of big crops, and unless the beekeeper takes the trouble to requeen in the summer only a small proportion of the stocks will yield a surplus.

In order to facilitate the work of queen-rearing a few nucleus colonies should be run in conjunction with every apiary. In these small colonies queens can be raised and cared for until they are mated and laying. It is an easy matter, once the queens are laying, to transfer them to the larger hives in the apiary. Perhaps no branch of apiculture receives less attention than the production of young queens, and yet if the beekeepers who get the big crops of honey are asked what counts most in their production the reply is invariably "young queens." In New Zealand it has been proved over and over again that the best months for raising queens are from November to January. During this period everything is favourable for the operation, as the hives are at their highest state of prosperity. Under normal conditions the workers and drones are at their best, this being the swarming-period.

The best style of nucleus hives to adopt is the four-frame one. This size will give the young queen a chance to lay once she is mated, and will, besides, hold sufficient bees to care for relays of queen-cells throughout the season. To form a nucleus colony take one frame of well-capped brood with adhering bees, and one frame containing honey and pollen, the remaining space being filled with an empty comb and feeder. If the number of bees on the comb is not sufficient to form a good cluster, one or two frames of young bees may be shaken into the nucleus, this being done to replace the field-bees which return to the old hive. Place the frame of brood in the middle of the hive and close the entrance until the following day, when the bees may be released. In the course of a day or two the small colony will settle down, and will then be ready to receive the first queen-cell.

No better plan can be followed by the beginner than to utilize queen-cells produced naturally—that is, under the swarming impulse. In removing cells from the hives select the largest and most corrugated ones, and cut well into the combs so as not to injure the queens. Care must be taken not to shake the combs containing the queen-cells, as the sudden jolt jerks the larva from its base and the embryo queen will be destroyed. Before inserting the cell in the nucleus hive be sure and examine the comb, in case eggs were transferred with the frame of brood. Should queen-cells be found, destroy these, and the cell can then be grafted with safety. A hairpin makes an excellent tool for holding the cell in position. If the weather conditions are favourable the queen should be laying within a week

after hatching, and when eggs appear in the hive the beekeeper may conclude that she is safely mated. Leave the queen in the nucleus hive until she has proved her laying-capacity, when she may be taken to replace an old or failing one in the apiary. If more queen-cells are available, which is almost certain to be the case where swarming is in full swing, a ripe one may be inserted to take the place of the young queen, and this can be repeated at intervals until the necessary number of queens is raised.

It must be left to the beekeeper to regulate the number of nucleus hives he requires, this depending upon the number of queens to be raised. There are several methods of artificial queen-raising, and details of these can be obtained from text-books on the subject. *

FOUL-BROOD.

Nothing retards successful beekeeping more than the ravages of foul-brood, and if bees are to become profitable every effort must be concentrated on the eradication of this disease. As advised previously, the beekeeper should familiarize himself with the symptoms, so that he can detect the appearance of the disease in its early stages. No set time can be given for its treatment, but it may be carried out as soon as settled weather sets in and when nectar is being freely gathered. There are many methods of treating the disease, but none is so effective as the McEvoy plan. Some of the systems practised are extremely dangerous in the hands of the beginner, and he will be wise if he keeps to the McEvoy treatment, which is the best and safest method practised. When treating a colony there should be sufficient bees to form an average-sized swarm. If, however, disease has reduced the colony until there is only a small cluster of bees left, it is advisable to destroy the colony, and remove all infected combs and the hive to a place of safety until such time as it can be properly cleansed. Full particulars for the treatment of foul-brood are contained in the Department's Bulletin No. 1, which can be obtained free on application.

A word of caution may be given to the beekeeper in whose colonies disease reappears after treatment. Many beekeepers resort to cutting out the infected cells, and even some text-books advocate this dangerous practice, but it is only tinkering with the disease. Such advice is misleading, and is certainly not effective in eradicating the trouble. When diseased cells reappear after treatment by far the safest plan is to make use of a modified form of the McEvoy method. In place of shaking the bees on to strips of foundation or "starters" for four days, the bees are shaken on to nine sheets of foundation and an empty "bone-dry" comb, this being inserted in the centre of the hive. At the end of twenty-four hours the comb can be removed, and a frame containing a sheet of foundation put in its place. This operation should be performed quietly and quickly, with the use of very little smoke. The object of inserting the dry comb in the centre of the hive is to induce the bees to store the honey which they took from the diseased hive when shaken. When removing the comb this diseased honey is also removed. If carried out with care this treatment will be entirely successful.

STIMULATIVE FEEDING.

As advised previously, a constant watch must be kept on the stores in the hive. During the flow from the willows and fruit-bloom brood-rearing is increased enormously, and the stores will rapidly dwindle during the period that follows. In order to keep up the strength of the colonies after the cessation of the fruit-bloom artificial feeding should be resorted to until the beekeeper is certain that the clover is yielding nectar. In most districts there is a distinct break between the spring blossom and the clover, and it is not uncommon to find populous hives on the verge of starvation. Hives that are gently stimulated will respond to the treatment and be in good order to work the main clover crop.

The quantity of syrup to be fed will depend largely upon the strength of the hives. If stimulative feeding has to be resorted to, sugar syrup may be fed in a less concentrated form than that which is given in the autumn and spring months, the quantity of water being increased. A syrup fed in the proportion of one of sugar to six of water is all that is required to stimulate the bees and prevent starvation, and will be the means of keeping the colonies strong in brood and bees. It must be remembered that it is strong colonies which count in a flow, and no others should be tolerated during the busy season.

—E. A. Earp, *Senior Apiary Instructor.*

THE GARDEN.

PESTS AND DISEASES.

THE best protection for plants from ills to which they are heir is a suitable environment and generous, skilful treatment; little else is usually required to return an abundant crop. Such conditions secure a strong plant of true type which will resist disease and outgrow the attack of insects. Occasionally, however, under these conditions troubles arise, and under less advantageous circumstances they are sometimes serious, so that a gardener is wise to have a few remedies at hand in case of need. Quiet observation occasionally will detect that need as soon as it arises—will, indeed, often anticipate it and ward off loss and disappointment.

Caterpillars of kinds—especially that known as the “leaf-roller”—do a great deal of damage to foliage and fruit. Foliage thus spoiled cannot fulfil its function, and the plant is checked in its growth. Should this trouble appear during a dry spell the consequences will be serious unless a remedy is applied. We have a great advantage over the last generation of growers in having such a sure remedy as arsenate of lead for this purpose. Two ounces of this paste (or 1 oz. if in powder form) gradually worked into a thin cream and then mixed with 4 gallons of water and sprayed on the plants is certain defeat for such enemies.

Most plants have a special variety of lice (aphids) which only require favourable conditions in the way of weather or a weakened

plant to demonstrate their wonderful fecundity, and by feeding on the juices of the plant, which they suck up, stop its growth. In a dry season cabbage and broccoli plants are specially susceptible. The insects will be found on the backs of the leaves where the elaborated sap can be reached, and the choicest varieties receive their special attention.

Before putting out plants they should be carefully examined, and, if necessary, first dipped in a suitable wash. Many proprietary washes are sold for this purpose. One of the most popular is a nicotine concentrate, 3 teaspoonfuls of which in 4 gallons of water will effectually cleanse the plants. Two ounces of common soap dissolved in the water first makes a more effective mixture. This wash forms an efficient spray for insects of this class on any kind of plant during the growing-period.

Another set of conditions readily cause certain fungus troubles to become epidemic at this season of the year, and the wary grower is on his guard against onion-mildew, potato late blight, and leaf-spot of kinds in raspberry, currant, gooseberry, and strawberry gardens, which may, gradually or suddenly, cause wholesale losses. Such growers should have supplies of bluestone and lime, also lime-sulphur concentrate, at hand, and deal with the difficulty as it arises. The best protection, however, is that first mentioned, and sprays cannot be entirely satisfactory without them.

POTATOES.

Potato crops in this country are too often sadly mixed in the way of variety, or composed of declining strains. Until certificated seed can be obtained the growers of moderate areas would act wisely if they carefully rogued their plots when the plants are in full flower and growth. Study carefully the true type of the variety grown, and dig up at once and dispose of all plants that depart from it in any respect. From the remainder, when mature, seed (sets) may be selected, but even these should be picked over, and any departure from the true tuber type should be discarded. The improvement in the quality and quantity of future crops would amply repay the trouble taken. As a half-measure, the method of marking rogue plants with a stick in the ground beside them, and when harvesting the crop digging them first and keeping that portion of the crop carefully separate for table use, while selecting seed from the remainder, can be recommended as an alternative.

VEGETABLE-CULTURE.

Most of the main crops will now be fairly started and have taken charge of the land allotted them. The preparation of the ground for winter crops should now be brought to a conclusion. Brussels sprouts, broccoli, savoy cabbage, and kale, celery, and leeks form an important section in the food-supply during the winter months. They are all alike in requiring good rich land, and usually form a class of their own in crop rotation, the remains of the heavy manuring applied on their behalf suiting admirably the more delicate requirements of the root crops that follow.

Celery and leeks may be planted out as soon as the plants are ready. For celery, the trenches should run north and south, and be 4 ft. from centre to centre for single rows; wider trenches for two or more rows are sometimes made. In the bottom a quantity of good soil must be placed, together with about an equal quantity of the old hotbeds or similar material. When it has settled down the plants can be put in 6 in. or 8 in. apart. Water the plants the day before lifting, and lift them with a trowel with roots intact. Solid, nutty sticks can only be secured by growing these plants without a check.

Leeks are usually planted in a shallow trench about the same distance apart. Shorten the leaves a little, and with a dibber put the plants in deep, but refrain from firming them.

For the other plants mentioned the land must be ready towards the end of December.

TOMATOES.

The grower of tomatoes under glass will now be settling down in earnest harvesting his crop, with the busy Christmas demand ahead of him. While the packing of many growers is excellent, there are a number who do not appreciate the importance of a neat, smart appearance in the package. The ideal of standard packages may still be some distance in the future, but more should be done in the way of approximate sizing and systematic packing.

It may appear difficult, slow, and tedious, but the experience of packing other fruit in this way is that after a little practice it is really quicker than a random pack that has to be fitted. The matter of maturity is another important point that is sometimes overlooked. The high prices for early fruit may tempt one to pick the plants rather bare, but such action is a mistake, as green immature fruit can never be satisfactory and will soon create a feeling of distrust on the market. The fruit must be mature even if not coloured. It can be identified by a slight change in the green colour, and more readily by cutting one or two fruits in two. The earliest pickings in small establishments do not permit of much classification, but every opportunity should be taken of grading the fruit for maturity. Call the grades "Mature," "Pink," and "Ripe," or what-not; the point is to observe carefully that the grades are kept separate. Mixed grades in fruit-packing are the cause of great loss and anxiety in retail stores, and they should be avoided as much as possible.

THE BERRY HARVEST.

The berry harvest also is at its height. The growers of the popular strawberries, raspberries, and currants will have long and busy days for a few weeks. In districts where the production is large there are possibilities of a congested market owing to the slackening demand from the jam-factories, but the popularity of this fruit is sufficiently great to easily absorb the crop if it is suitably packed and transported promptly. The season for these berries is short, and the fruit is very perishable, but effective advertising and a daily transport service will easily clear this crop of choice delicacies. Here are two points on which the berry-growers' associations may render valuable service.

TOBACCO-GROWING.

The tobacco crop will now be well established, and every attention should be given it in order to secure steady uninterrupted growth, or, in other words, a large crop of sound leaves of the right type and size. Quality in the work will put quality into the leaf, and on this the price depends. It will be remembered that the early harvest of last season gave a wonderfully improved cure, and efforts should be made to maintain this advantage. Harvested in bright, dry, warm weather the leaves possess those gums and oils on which their aromatic qualities depend. The warm, dry atmosphere also facilitates curing.

There are two systems of curing operating in this country—flue curing and air curing. The former requires a suitable shed with small brick furnaces on the outside of the building, the heat from them being carried round the lower part of the interior through large sheet-iron flues. By this method the popular yellow tobaccos of the present day are cured.

Air curing, however, is the method in more general use. For this purpose the ideal building is rather high, with large doors to facilitate loading and unloading, and ample ventilation in the roof, and sides that can be closed or opened. The principles underlying the process are the proper manipulation of temperature, humidity, and draught. Inside, posts are erected which carry tier poles 4 ft. apart and one above another at a distance of about 4 ft. On these the 4 ft. curing-sticks rest when loaded. Many growers will have to adapt for the present season such buildings as exist on the farm. This will require considerable planning and occupy some time to carry out, and should be taken in hand without delay. Too often a good crop is heavily depreciated by bad handling, due to lack of such preparation. Efforts to cure the leaf on stages in the open has been a failure, and valuable leaf was wasted last season in the attempt. The wind and rain experienced during the autumn months resulted in a bruised, washed-out condition that rendered the leaf useless.

—W. C. Hyde, *Horticulturist*.

INVENTIONS OF AGRICULTURAL INTEREST.

APPLICATIONS for patents, published with abridged specifications in the *New Zealand Patent Office Journal* from 18th September to 16th October, 1924, include the following of agricultural interest.—

No. 50816: Shearing-machine; A. M. Kobiolke, Gilderoy, Victoria.
 No. 50819: Milking-machine pulsator; G. J. G. Fraser, Otautau. No. 52252: Milking-machine; N. J. Daysh, Palmerston North. No. 52520: Inflation and teat-cup protector; M. J. O'Connell, Clandeboye. No. 50750: Cream-separator; A. H. Wilkinson, Busselton, West Australia. No. 60917: Teat-cup; L. B. Dougherty, Hamilton East. No. 52450: Seed and fertilizer spreader; W. Lyons, Roseberry East, Victoria. No. 52451: Sheep-shearing machine driving-means; L. McLachlan, Longreach, Queensland. No. 50468: Milk measuring and sampling means; C. M. Stanley and J. H. Stuart, Apiti. No. 51376: Milking-machine teat-cup suction cut-off; W. A. Shields, Sydney, N.S.W. No. 52489: Milking-machine teat-cup; J. G. Lamb, Melbourne. No. 52560: Incubator; Anderson and Entin-knap Proprietary, Prahran, Victoria.

Copy of full specifications and drawings in respect to any of the above may be obtained from the Registrar of Patents, Wellington; price 1s.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

DROPSICAL SWELLINGS IN HORSE.

C. K. WATKINS, Kaiwaka :—

About three months ago I noticed that the sheath of one of my horses was swollen up to more than double its natural size, and with this a soft swelling about 8 in. long, 4 in. wide, and 2 in. deep along the under part of his stomach. I turned the horse out, but he has been losing condition ever since. Could you suggest a cure?

The Live-stock Division :—

Dropsical swellings of the sheath and abdomen frequently occur in horses badly infested with worms. Under the circumstances, seeing that the horse is losing condition, a liberal amount of nourishing feed should be given. A mash of bran twice daily, with an occasional feed of crushed oats, also a few pounds of linseed boiled into a jelly, and a cupful of this mixed with the feed two or three times weekly will prove beneficial. Medicinally, you might try the effect of the following powder given mixed in the food once daily (chemist will make up a dozen powders). Powdered arsenic, 2 grains; carbonate of iron, 1 dram; nux vomica, 1 dram; gentian, $\frac{1}{2}$ ounce; powdered aniseed, 1 dram. It is advisable to cleanse the sheath with warm water and softsoap. Also, warm fomentations to the swelling might help.

RIDDING LAND OF RATTAIL.

W. McLEAN, Otoko :—

What is the best way to get rid of rat-tail—a very thick sward—on easy to fairly steep hills, ploughable? It does not turn over well with an ordinary double-furrow plough. Would a hillside disk or a strong heavy hillside swing-plough be better?

The Fields Division :—

A heavy growth of rat-tail forms one of the most difficult swards to deal with. It is generally considered that one ploughing is not sufficient to make a good job. The type of plough likely to give the most satisfaction is one with a long mouldboard and fitted with an adjustable undercutting skeith. This attachment can be procured from implement-dealers. The undercut furrow-slice obtained by using one of these attachments packs well, and covers roughage effectively.

DOG WITH DISCHARGE FROM EAR.

"CANKER," Kai Iwi :—

I have a young dog with a continual discharge from one ear, and would be pleased for any information regarding treatment.

The Live-stock Division :—

We advise you to give the dog a good dose of opening medicine. See that his bowels are kept relaxed, and feed on light easily digested food such as well-boiled sheep-paunch, with bread or vegetables in the soup. Thoroughly clean out the ear with warm water to which has been added a small piece of washing-soda—say, a piece the size of a pea in an egg-cup of warm water. Twist up a piece of cotton-wool on a hairpin and clean out the ear with it, being very careful not to injure the lining of the ear.

FEEDING BREWERS' GRAINS.

G. ARMSTRONG, Cobden :—

Having a quantity of brewers' grains on hand, I am desirous of knowing the feeding-value of same. Are they suitable to feed cows and pigs on ?

The Live-stock Division :—

Brewers' grains are quite suitable as a food for cattle and pigs if mixed with other foodstuffs. They have the property of increasing the milk-flow of cows, but they tend to decrease the proportion of solids in the milk. They are also useful for fattening purposes. It is not desirable to use grains over a long period, as they tend to cause digestive trouble. If the animals are hand-fed, about half a bushel twice daily mixed with other foods is about the proper ration for a full-grown cow.

PROPAGATING THE LAUREL.

R. SMITH, Cromwell :—

Could you inform me if it be possible to raise laurel-bushes from cuttings taken from the trees ; and, if so, which is the best method of raising same, and when ? For a trimmed hedge what distance should there be between each plant ?

The Horticulture Division :—

The usual way of propagating the common hedge-laurel is by cuttings. It is customary to cut back a strong-growing hedge in early winter and make the cuttings (about 9 in. long) from the well-ripened annual wood. Plant them out in a nursery bed in a shady situation, with about two-thirds their length in the ground, till they root. Afterwards they can be planted out in permanent quarters at a distance of 2 ft. apart.

HORSE WITH WORMS.

" CLYDESDALE," Lumsden :—

I have a young draught horse in work which occasionally passes a white worm (4 in. long by $\frac{1}{8}$ in. thick) in his dung. He keeps in poor condition, although fed plenty of good oat-chaff and worked little. Kindly inform me as to what treatment is necessary.

The Live-stock Division :—

We would recommend you to give the horse a drench of a pint of raw linseed-oil with two tablespoonfuls of turpentine. A week later give one tablespoonful of turpentine in a pint of milk.

LAMENESS IN PONY.

" PONY," Mangamingi :—

Some six months ago a pony I was riding on the hills went lame on one hind leg. There was nothing to show except a slight puffiness at the back of the leg just above the fetlock. She has been turned out since, but is still a little lame and a little swollen about the fetlock. Would this indicate a torn sinew ? Would putting a blister on it be likely to do any good ?

The Live-stock Division :—

This appears to be a windgall. Cases treated at once will often respond to a pressure bandage and cold-water applications. As this case is of six months' standing, it would be advisable to blister the part well, a fly blister being the most suitable. A shoe with a fairly high heel will take the strain off the parts. After the blister has worked out, apply cold water for an hour or two daily for ten days.

KILLING POPLAR-TREES.

C. A. CROFT, Amberley :—

Would you kindly advise me as to the quickest and cheapest method of killing poplar-trees while standing?

The Horticulture Division :—

To dispose of standing poplar-trees, bore two or three auger-holes into the lower part of the trunk of each tree in a sloping direction, fill them within an inch or so of the top with commercial sulphuric acid or weed-killer, and plug them up. This operation is best carried out about midsummer, or trouble is likely to be caused by the roots suckering.

DISPOSING OF CARCASSES.

T. A. H., Te Poi, Matamata :—

Please advise me how to profitably make use of a carcase. When, say, a horse dies, to bury it is a dead loss. If a carcase is well sprinkled over with quicklime and then covered over with, say, two or three times its weight of earth, and after a time the whole mass well mixed together, will the good of the carcase be in this earth so that it could be used? Or would the action of the lime burn all the good out of the carcase?

The Live-stock Division :—

The method proposed by you of disposing of carcases is to be condemned—firstly, on account of the grave risk of spreading disease to other animals, and, secondly, owing to the probability of its creating a public nuisance. Even if it were safe to dispose of carcases as suggested by you, a considerable amount of the manurial value would be lost in the process. A considerable amount of the nitrates would be given off in decomposition; the lime would drive off the ammonia; and the phosphates and lime contained in the bones would be lost on account of their not being ground. If a carcase cannot be disposed of to a boiling-down works, where the most can be made from it, the safest and most economic method is to have it properly buried.

PHORMIUM AND LIVE-STOCK.

J. HENDERSON, Riverhead :—

I would like to know the relative value of chaffed flax (*Phormium tenax*) as a food for horses and cows.

The Live-stock Division :—

We know of no feeding-experiment having been carried out with the phormium-plant, and the only observations noted have been some deaths among a few cattle due to the accumulation of fibre. The material has also been known to cause severe scouring in horses.

British Market for Peas and Beans.—The following advice was cabled by the High Commissioner, London, on 1st November: *Peas*—Bluc: Tasmanian "A" grade on passage sold at £21 c.i.f.; ex store quoted up to £22 per ton. Japanese market strong between £25 and £26 c.i.f. New Zealand No. 1 Partridge on passage offered for resale at 74s. to 76s. 6d. per 504 lb.; ex store, 70s. to 78s.; November-December shipment, 72s. 6d. c.i.f., nominal value. Tasmanian maple "A" sold on passage 76s. 6d.; November-December shipments, 78s. c.i.f.; very little spot trade, and quotations 82s. to 87s. 6d. *Beans*: English best winter, 52s. to 59s. per 532 lb.; spring up to 64s.; small business. Chinese horse offered at £11 per ton ex ship. Sales have been made afloat to Glasgow at £10 7s. 6d. and Liverpool £10 17s. 6d. per ton c.i.f.

WEATHER RECORDS: OCTOBER, 1924.

Dominion Meteorological Office

GENERAL SUMMARY.

THE weather during October was on the whole dull, warm and mild. It was remarkable for the end of the dry period which had been experienced, particularly on the east coast of the South Island. Warm rains occurred several times during the month, but snow fell on the higher levels on more than one occasion, particularly in the rear of the storm which was experienced about the 20th, when barometric pressure was very low, especially in the east coast of the North Island. Another storm was experienced at the end of the month in the same parts, when, however, the barometer was over an inch higher. Atmospheric conditions were very unsettled throughout the month, and the barometer unsteady. There were six areas of westerly low pressure and at least four ex-tropical disturbances, bringing changes in the weather. On only one or two days during the month was it fine throughout the whole Dominion, one part or another being subject to unsettled and showery weather. Rainfall was above the average in most parts, exceptions being chiefly in Otago and the Bay of Plenty. Northerly to westerly winds predominated.

—D. C. Bales, Director.

RAINFALL FOR OCTOBER, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches
Kaitia	4.94	17	0.96	4.48
Russell	4.34	15	0.87	3.27
Whangarei	6.17	17	0.96	4.58
Auckland	5.67	20	1.12	3.63
Hamilton	5.56	23	0.86	4.82
Kawhia	6.54	20	1.50	5.28
New Plymouth	6.98	21	1.78	5.47
Inglewood	11.58	22	1.86	10.37
Whangamomona	7.90	17	1.04	9.11
Tairua, Thames	6.72	18	1.52	6.89
Tauranga	4.52	19	1.24	5.31
Maraehako Station, Opotiki	6.12	15	1.74	5.50
Gisborne	3.54	11	0.62	2.84
Taupo	6.30	14	2.04	4.28
Napier	3.00	11	0.87	2.50
Maraekakaho Station, Hastings	7.20	16	2.85	3.09
Taihape	4.51	18	0.99	4.30
Masterton	5.43	16	1.59	3.34
Patea	5.40	18	1.50	4.11
Wanganui	3.39	12	1.00	3.65
Foxton	3.56	9	1.80	3.03
Wellington	4.56	15	1.46	4.12
<i>South Island.</i>				
Westport	10.07	22	2.38	6.97
Greymouth	11.11	22	1.66	10.66
Hokitika	15.24	22	2.82	11.88
Arthur's Pass	15.41	19	2.38	20.99
Okuru, Westland	21.32	19	3.10	15.37
Collingwood	7.97	21	1.20	11.03
Nelson	6.71	17	1.44	3.48
Spring Creek, Blenheim	6.28	12	2.48	2.39

RAINFALL FOR OCTOBER, 1924—continued.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average October Rainfall.
<i>South Island—continued.</i>				
	Inches		Inches.	Inches.
Tophouse	7.25	19	1.79	5.80
Hanmer Springs	6.76	14	2.06	2.60
Highfield, Waiau	6.36	12	1.90	2.46
Gore Bay	4.36	10	1.65	1.80
Christchurch	3.78	15	1.25	1.65
Timaru	4.02	14	1.14	1.97
Lambrook Station, Fairlie	4.46	12	1.78	2.00
Benmore Station, Omarama	3.14	14	0.84	2.09
Oamaru	3.63	15	0.98	1.66
Queenstown	2.66	14	0.85	3.60
Clyde	2.39	10	0.58	1.58
Dunedin .. .. .	..	..	..	3.03
Gore	2.07	15	0.98	3.35
Invercargill	3.08	18	0.94	4.57

GRADING-POINTS FOR EXPORT BUTTER AND CHEESE.

THE following circular was issued by the Director of the Dairy Division to all dairy companies on 7th November:—

The suggestion that the minimum points for first-grade butter and cheese should be raised from 88 to 90, on the principle discussed with representatives of dairy companies during the past winter and spring, has been considered by the Hon. the Minister of Agriculture, and has received his approval.

From the 1st January, 1925, the nominal minimum will therefore be 90 points for first-grade creamery butter and factory cheese, and 88 points for whey butter.

The present 89-point quality for cheese will ultimately be recognized as the minimum quality for first grade, and will be scored 90 points by adding 1 point to the score for flavour.

After 1st January, 1925, for the remainder of this season the grading on the new basis for first grade will be so eased that butter and cheese will be classed first grade if, on the basis obtaining hitherto, they would score one-half point below the new minimum. Thus, after 1st January until the end of the season the Graders will bring into first grade (a) creamery butter which would score hitherto 89½ points, (b) factory cheese which would hitherto score 88½ points, and (c) whey butter which would hitherto score 87½ points.

The evidence received from the United Kingdom, and the general consensus of opinion amongst dairy companies, indicate that it is necessary, in the interests of the suppliers to dairy factories in New Zealand, to take action along the foregoing lines.

IMPORTATION OF FERTILIZERS: SEPTEMBER QUARTER.

FOLLOWING were the importations of fertilizers into New Zealand for the quarter ended 30th September, 1924: *Sulphate of Ammonia*: From Australia, 238 tons. *Nitrate of Soda*: Chile, 755 tons. *Basic Slag*: United Kingdom, 5,685 tons; Belgium, 1,308 tons. *Chardust*: Australia, 101 tons. *Bonedust*: Australia, 20 tons. *Guano and Rock Phosphate*: United Kingdom, 10 tons; New Caledonia, 3,968 tons; Nauru Island, 18,015 tons. *Phosphates, other*: Egypt, 3,300 tons. *Kainit*: United Kingdom, 170 tons; Germany, 225 tons; Belgium, 19 tons; France, 133 tons. *Sulphate of Potash*: United Kingdom, 35 tons; Germany, 130 tons; France, 8 tons. *Potash, other*: United Kingdom, 107 tons; Germany, 80 tons; France, 260 tons. *Sulphate of Iron*: Australia, 13 tons. *Miscellaneous*: United Kingdom, 3 tons.

TREES ALONGSIDE BOUNDARY-LINES: THE LEGAL POSITION.

IN the *Journal* for July last (page 68) was published a reply to an inquiry regarding the legal position under the Fencing Act as to a plantation put in 6 ft. from a boundary-fence. The question as to what constitutes "alongside any boundary-line" under the Act had, as far as we were then aware, not been determined. A correspondent has since drawn our attention to the case of *King v. Cohen*, taken at the Magistrate's Court, Hastings, Hawke's Bay, in 1922, in which this point was covered. The judgment of Mr. R. W. Dyer, S.M., is self-explanatory, and is published for general information, as follows:—

These proceedings are taken under section 26 of the Fencing Act, 1908. The plaintiff and defendant are adjoining owners and occupiers of land in the Mecanee district. The defendant planted willows about 4 ft. from the boundary-fence for a distance of 230 ft. along the boundary, and a row of *Pinus insignis* about 18 in. from the willows, without the previous written consent of the plaintiff. The plaintiff states that the trees shade his land, that the foliage of the willows drops on his land, and that the roots of the trees exhaust the soil. The defendant states that he planted the trees as a shelter for his orchard, and that they in no way injure the plaintiff. Section 26, in so far as it relates to the present proceedings, is as follows: "No person shall, whether for the purpose of making a live fence or otherwise, plant or sow gorse or trees on or alongside any boundary line or fence without the previous written consent of the occupier of the adjoining land." And every one who commits a breach of any of the provisions of the section is liable for every such offence to a fine not exceeding £20. Subsection (4) of section 26 provides that, irrespective of any such fine, the occupier aforesaid may enter on the land and cut down, uproot, and destroy all gorse or trees, &c., planted or sown in breach of the section, and may recover the cost of so doing from the person who planted or sowed the same. I am now asked to convict the defendant for having committed a breach of this section. The defence raised is that the trees are not planted on or alongside the boundary line or fence, and that, therefore, the defendant ought not to be convicted.

It is clear that the trees are not planted on the boundary. Can it be said that they are planted "alongside" it? Section 26 has quite recently been considered both in the Supreme Court and Court of Appeal. In *Spargo v. Levesque* (1922, G.L.R. 37) it was held by Salmond, J., in the Supreme Court that the right of an occupier to enter adjoining lands and to cut down and destroy trees planted thereon in breach of section 26 of the Fencing Act, 1908, can only be exercised against the occupier who planted the trees and not against his successor in title. And by the Court of Appeal that right can only be exercised after proceedings have been taken against the person planting the trees for a breach of the section and a conviction obtained; and that the word "alongside" in section 26 must be read and construed as "contiguous to" or "closely side by side." Stringer, J., who delivered the judgment in the Court of Appeal, in dealing with the word "alongside," says: "The trees, to come within the prohibition, must be planted on or 'alongside' the boundary line or fence. What is the meaning of 'alongside'? Having regard to the fact that the Fencing Act is concerned only with fences separating the lands of different occupiers, or, in other words, boundary-fences, we think the word 'alongside' must be read and construed as contiguous to or closely side by side. Unless this construction is adopted the word cannot be given any definite meaning at all. If a tree planted 4 ft. from the boundary were held to be planted 'alongside' the boundary, what is to be said of a tree planted 6 ft., 8 ft., or 10 ft., or more from the boundary? When the learned counsel for the appellant was asked at what distance from the boundary trees could be planted without infringing the terms of the section his answer was that it would vary according to the nature of the trees planted. It is clear, therefore, that, whatever the proper interpretation of the word 'alongside' may be, questions must arise as to whether in particular cases the trees complained of were in fact planted 'alongside' the boundary."

Mr. Scannell (for plaintiff) contends that the point actually decided by the Court of Appeal was that the right of entering on the land of an adjoining occupier and cutting down and destroying trees can only be exercised after proceedings had been taken and a conviction obtained against the person offending, and that the portion of the judgment that I have quoted is only *obiter*, and therefore not a direct ruling. Further, that the expression "closely side by side" is just as indefinite as the word "alongside," and that the Court of Appeal has purposely refrained from giving any interpretation to the word "alongside"; and that the matter remains exactly where it was before—namely, that "alongside" remains undefined. It is true, no doubt, that the remarks made on the word "alongside" were *obiter*, but I think, nevertheless, that they were intended as a judicial interpretation of what the word means as used in the section under review. The words in the statute are "on or alongside"—that is, on the boundary-line or close to it. "Contiguous to" means, as I understand it, that there is a point of contact between the trees and the boundary-line—that is to say, that the trees are touching the line. "Closely side by side" means, I think, that although the trees may not actually touch the boundary-line, they nearly do so or almost touch. If I am correct in this, I think it is clear that the trees in question are not alongside the boundary-line. The willows are about 4 ft from the line. In the judgment in *Spargo v. Levesque* (1922, G.L.R. 37) the question is put, "If a tree planted 4 ft from the boundary were held to be planted 'alongside' the boundary, what is to be said of a tree planted 6 ft., 8 ft., 10 ft., or more from the boundary? It seems clear from this that the Court of Appeal would hold that a tree planted 4 ft from the boundary was not 'alongside' the line."

I think there is a good deal to be said for Mr. Lusk's contention (for defendant) that the Fencing Act deals with fencing only, and in no way interferes with the common-law rights of adjoining owners in respect of overhanging branches of trees and cognate matters. These remain the same, and are not abrogated by the statute. I think, therefore, that the summons should be dismissed, with costs, upon the ground that the trees are not planted "alongside" the boundary-line.

ESTIMATED AREAS UNDER WHEAT AND OATS.

THE following estimates of the areas under wheat and oats in the Dominion for the current season have been issued by the Government Statistician, under date 27th October, the figures being based on the usual card census: Wheat—North Island, 3,000 acres, South Island, 107,000 acres: total, 170,000 acres. Oats—North Island, 55,000 acres, South Island, 425,000 acres: total, 480,000 acres. The corresponding final totals for the previous season (1923-24) were 178,652 acres of wheat and 417,377 acres of oats. In the current season's wheat-sowings the areas under the different varieties are given as follows: Tuscan or longberry, 115,194 acres; Hunters (various), 32,210 acres, Velvet or Pearl, 13,868 acres; balance unspecified.

TICK REGULATIONS REGARDING GOATS.

ADDITIONS have been made to the regulations for the prevention of the spread of ticks (*Ixodidae*) among stock so as to include goats. Any person desiring to remove goats from Area A must first obtain a permit in the prescribed form from an Inspector, or some other person authorized by an Inspector, authorizing their removal, and such goats may thereafter leave Area A only at the place and within the time specified in such permit. If goats intended to be removed from Area A are found to be harbouring ticks a permit will not be issued unless and until such goats have been so treated as to ensure the complete destruction of all cattle-ticks upon the legs by immersion in an effective tick-destroying fluid, or by some other effective method at the discretion of the Inspector, or on the head by spraying or sponging with the same fluid. The new regulations were gazetted on 30th October, and came into force on the same date.

THE SEASON'S LAMBING: NORTH ISLAND ESTIMATE.

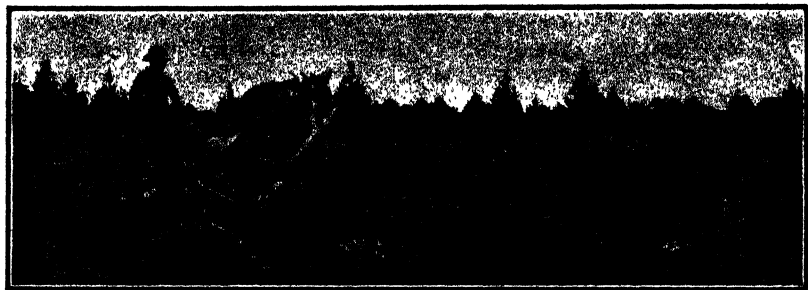
FROM information furnished by the Inspectors of Stock in the various districts the average lambing for the current season in the North Island is estimated at 85 per cent. With 7,148,949 breeding-ewes in the North Island, as shown in the 1923 sheep returns, the number of lambs is estimated at 6,049,652. South Island and Dominion estimates will appear in next month's issue.

FORTHCOMING AGRICULTURAL SHOWS.

Otago A. and P. Society : Dunedin, 26th and 27th November.
 Stratford A. and P. Association : Stratford, 26th and 27th November.
 Hauraki A. and P. Association : Paeroa, 26th and 27th November.
 Wyndham A. and P. Society : Wyndham, 5th December.
 Southland A. and P. Association : Invercargill, 9th and 10th December.
 Rangitikei A. and P. Association : Taihape, 14th and 15th January.
 Woodville A. and P. Association : Woodville, 20th and 21st January.
 Waimarino A., P., H., and I. Association : Raetihi, 22nd January.
 Tapanui Farmers' Club : Jubilee Show, Tapanui, 28th January.
 Pahiatua A. and P. Association : Pahiatua, 30th January.
 Clevedon A. and P. Association : Clevedon, 7th February.
 Dannevirke A. and P. Association : Dannevirke, 11th and 12th February.
 Te Puke A. and P. Association : Te Puke, 12th February.
 Rodney Agricultural Society : Warkworth, 14th February.
 Northern Wairoa A. and P. Association : Mititai, 17th and 18th February.
 Masterton A. and P. Association : Solway, 17th and 18th February.
 West Coast A. and P. Association : Greymouth, 18th and 19th February.
 Rotorua A. and P. Association : Rotorua, 20th February.
 Waiaapu P. and I. Association : Ruatorea, 25th and 26th February.
 Tauranga A. and P. Association : Tauranga, 26th February.
 Opotiki A. and P. Association : Opotiki, 26th February.
 Franklin A. and P. Association : Pukekohe, 27th and 28th February.
 Omaha and Pakiri A. and H. Association : Leigh, 28th February.
 Taumarunui A. and P. Association : Taumarunui, 4th March.
 Waikato Central A. Association : Cambridge, 4th and 5th March.
 Mangonui A. and P. Association : Mangonui, 6th and 7th March.
 Morrinsville A., P., and H. Society : Morrinsville, 11th March.
 King-country Central A. and P. Association : Te Kuiti, 12th March.
 Matamata A. and P. Association : Matamata, 19th March.
 Mayfield A. and P. Association : Mayfield, 21st March.
 Methven A. and P. Association : Methven, 26th March
 Temuka and Geraldine A. and P. Association : Winchester, 2nd April.

Agricultural and Pastoral Association Secretaries are invited to supply dates and location of their shows for publication in this list.

Area under Potatoes.—The Government Statistician estimates the area under potatoes this season (1924-25) as 6,000 acres in the North Island and 18,000 acres in the South Island, or a total of 24,000 acres. The corresponding final figures for the 1923-24 season were 5,630, 15,363, and 20,993 acres respectively. Only holdings of 1 acre and over outside borough boundaries are covered by these figures. A fair aggregate area of potatoes is grown on the smaller holdings and within boroughs.



The New Zealand Journal of Agriculture.

VOL. XXIX.—No. 6.

WELLINGTON, 20TH DECEMBER, 1924.

A RECONNAISSANCE SURVEY OF PUMICE SOILS.

ROTORUA COUNTY.

(Continued.)

B. C. ASTON, F.I.C., F.N.Z.Inst., Chemist to the Department.

THERE is no land in New Zealand which is so neglected in settlement as that of the pumice type. Any knowledge that can be gained which will lead to an increased utilization of pumice lands as a whole will, owing to the vast areas which are available, the low price of these, and the ease with which they may be cleared and roaded, contribute largely to the prosperity of the Dominion. But there is pumice and pumice. To the optimist, and one possibly without practical experience of the difficulties in farming the worst kinds, all pumice lands are latent with wealth and only await railways, roads, and harbours to realize a golden harvest, while to the practical pessimist who has failed on one of the difficult pumice types all kinds are anathema. Each commentator may be in a measure right, but errs in arguing generally from different premises.

It is the aim of this series of articles to classify the different types of pumice soils so that any may be recognized, and that none may suffer unjustly from evil reputation of a neighbour or prosper inequitably from a false comparison. It is not claimed that such initial investigation will resolve all difficulties; but classification is the first step to a clear understanding—that when the facts are known reason may exercise its judgment.

I. MAMAKU—concluded.

Before leaving consideration of the area described under the heading of Mamaku the writer would draw attention to the illustration showing the relation of the soil, subsoil, and underlying rock (Fig. 1). In this quarry at Mamaku the sharp line of demarcation between the hard rhyolitic rock and the soft pumice-gravel subsoil is well shown. The roots of the tree indicated by the remaining stump descended through the subsoil until they rested directly upon the rock, but could not penetrate it. The absence of any parting layer of soil, weathered rock, or organic matter between the rock and the gravel will be noticed. Above the yellow pumice gravel the subsoil passes imperceptibly into the mixture of partially decayed pumice and organic matter forming the soil.

A further collection of analyses of samples from the Mamaku district is given in the accompanying tables, which confirm the statement as to the uniformity of the mechanical composition of each type of soil over a large area. Some additional analyses are given of the "birch" soils, and of the cultivated and grassed soils of the Mamaku Demonstration Farm.

Fig. 2 shows a typical scene on the main Rotorua-Lichfield Road, about four miles distant from the Mamaku Farm, near Steele's old mill. Between these points the country is similar, showing great constancy to type.

II. ROTORUA BASIN.

The geological history of the lands within the Rotorua crateriform depression is more varied. They may be comprised in the following classes: (1) Lake-terraces overlain by ejected material, including (a) Rotorua pumice shower, (b) 1886 eruption mud; (2) recent lake-terraces; (3) river-terraces.

(1.) A great distinction must be made between the lands on the eastern, or Te Ngae, side of Lake Rotorua (b), which have been covered with calcareous mud deposits since 1886, subsequent to the Rotorua pumice shower, and those lands (a) which have not had the benefit of this top-dressing. This distinction makes a very great difference to the agricultural value of the lands, not only from the lime present in the mud but also from the finer nature of the material.

(2.) Recent lake-terraces are those which have been recently and are still being formed at lake-level by the subsidence of the waters, which is still taking place. In many of these there is evidence of coarse pumice having been left as beaches round the lake. The soils of these lake-level terraces differ from others in the greater water content, which is difficult to demonstrate in analyses of samples. In these almost submerged lands the water is so free and abundant that it runs out of the soil in the process of lifting the latter. It is, however, evident that the lands are often saturated with water. It is on such coarse soils, which are growing a pasture that would be deemed poor by the ordinary farmer, consisting largely of Yorkshire fog and other weeds, that bush-sick stock recover when pastured there.

Gile ("Cause of Lime-induced Chlorosis and Availability of Iron in the Soil," *Journal of Agricultural Research*, October, 1920, vol. 20, p. 34), in experiments with rice, found that, although rice becomes

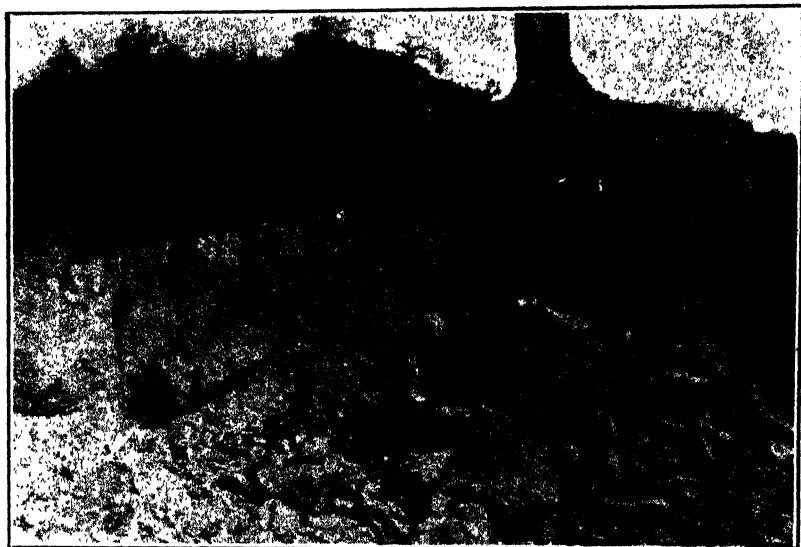


FIG. 1. SHOWING DEPOSIT OF PUMICE ON TOP OF RHYOLITE ROCK AT QUARRY NEAR MAMAKU.



FIG. 2. TYPICAL MAMAKU PHYSIOGRAPHY ON CLEARED LAND.

Rhyolite necks or pillars at cross-roads between Mamaku and Steele's Mill.

[All photos by B. C. Aston.]

chlorotic (free from green colouring-matter) in calcareous soils with ordinary percentages of water, it will grow normally in certain calcareous soils if the soil is submerged. Many of the Rotorua lake-side soils for a great part of the year may be so saturated with water that they can be described as nearly submerged. Chlorosis in plants is a condition which Gale attributes to a depression in the availability of iron in the soil, and he concludes that rice may be expected to make practically a normal growth if the soils are submerged. This point of view is extremely interesting as affecting bush-sick country. One may reason that as coarse pumice soil at lake-level is free from bush sickness, although derived from the same class of material as that at Mamaku, the proportion of the water in the soil is the great factor in effecting the change for the better. It is, of course, impossible to submerge the bush-sick lands, but their water-holding capacity may be increased by cultivating, compacting, and green-manuring. By such means may the pumice-particles be made to decompose and yield up their stores of plant-food—particularly iron—which are so obstinately held. As showing how readily under favourable conditions, with the aid of stagnant water and decaying plant-remains, the iron and manganese may be liberated from coarse pumice soils, the photograph, Fig. 4, may be studied. At the Railway quarry near the Rotorua Railway-station, at some quite recent date geologically, marshy conditions must have prevailed, the result being that a large amount of the iron and manganese was leached out of the first few feet of pumice and redeposited where the subsoil became much coarser. The dark nature of the underlying stratum is caused by the coating of the pumice gravel with oxides of iron (brown) and manganese (black) which have been leached out of the top soil.

(3.) River-terraces are comparatively rare, and, being of small acreage, are unimportant, but are often lands of high fertility.

NATURAL VEGETATION.

Hall and Russell (vol. 4, *Journal of Agricultural Science*) lay stress on the fact that coarseness of soil must be studied in connection with climate (particularly rainfall and temperature). Exact meteorological data for comparison of the Rotorua series of soil with the Mamaku series are, unfortunately, not available. Climatically those stations are different, Mamaku being some 800 ft. above Lake Rotorua and the temperature being lower. The rainfall may be heavier. These climatic differences may have had their effect in the great difference to be found in the natural plant covering of the two areas. At Mamaku it is all forest, but at Rotorua there is a very puzzling vegetation. With the exception of the Te Ngae lands on the east side of the lake, there is nothing like the Mamaku forest until the hill forests are reached at some 500–600 ft. above the lake. Swampy forest is developing in wet places round the lake, white-pine-pukatea forest at Te Ngae, and pure white-pine at Ngongotaha. When, however, one leaves the swampy shores only manuka or fern is encountered. Dieffenbach ("Travels in New Zealand"), in 1843, was puzzled by the curious distribution of the woods, and his solution, deduced from the presence of charred stumps, is perhaps partially true, that the great absence of forest within the Rotorua crateriform depression is due to the activity of



FIG. 3 TYPICAL "BIRCH" FOREST, MAMAKU.

Samples R 946, 1126, and 1156 are representative of this soil.

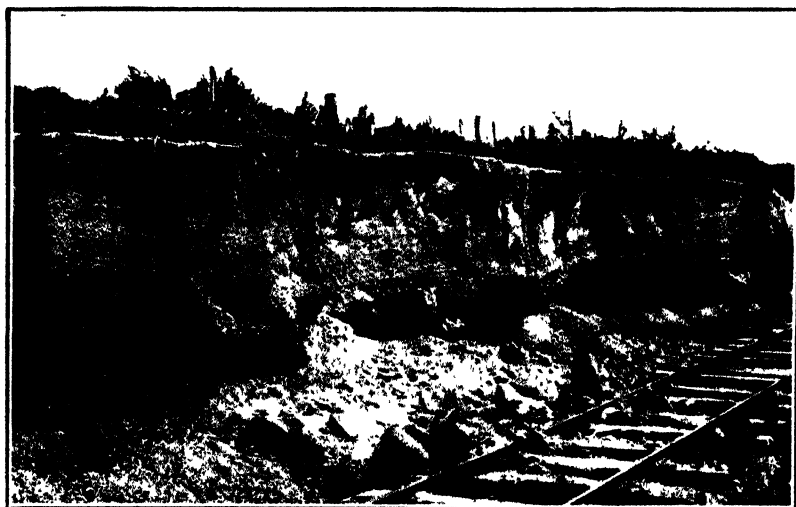


FIG. 4. SECTION OF PUMICE-GRAVEL PIT AT ROTORUA, SHOWING PAN FORMED BY LEACHING OUT OF IRON AND MANGANESE.

The dark stratum along the foot of the pit has resulted from deposition of the iron and manganese.

the Natives in clearing the country for their cultivation. A patch of rimu-tawa forest may be seen on the Te Ngae flat, but this is the only exception of dry-land forest which the writer has encountered on the lowlands, and the preservation of this may be due to the missionary influence in early years.

Fletcher ("Recent Changes in the Vegetation of the Taupo District," *Trans. N.Z. Inst.*, vol. 47, p. 70, 1914) is of opinion that the succession of the vegetation at Taupo was in the following order: Fern, tussock-scrub, forest. If this succession holds true, in Rotorua the native growth at the lower levels has only reached the scrub stage, two species of manuka (*Leptospermum scoparium* and *L. ericoides*) being the predominating shrubby plants on the lower levels, while the higher levels

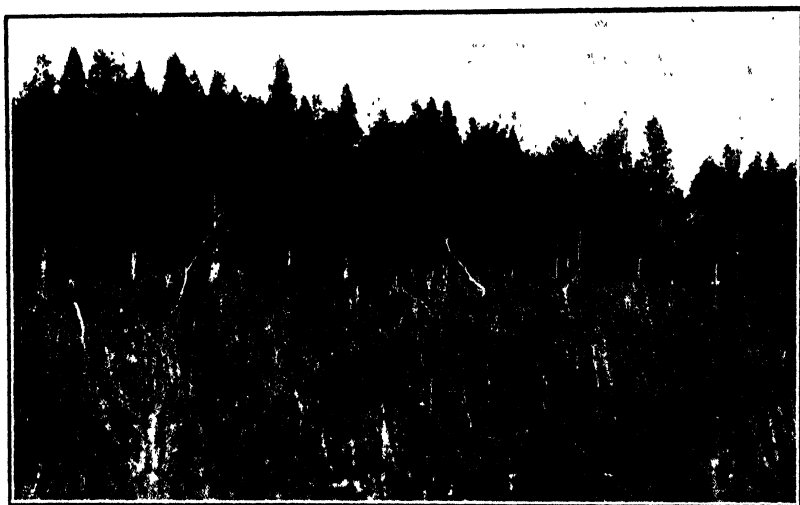


FIG. 5. SWAMPY FOREST DEVELOPING AT NGONGOTAHA, NEAR ROTORUA.

Conditions here, on the lake-border, are ideal for quick growth of young white-pines. Scrub in foreground is manuka. Sample R 1147 represents this soil.

are still in the fern stage, *Pteridium esculentum* (New Zealand bracken) and *Coriaria ruscifolia* (tutu) being the predominating growth. Where thermal activity is present a variety of scrubby growth exists, and where swamp conditions occur special associations of herbaceous swamp plants are also present in fairly large areas, but these are not of agricultural importance.

The only correlation between soil and vegetation detected in the Rotorua district is the occurrence of distinct types of forest in very wet subsoil. At Ngongotaha a pure wood of young white-pine (*Podocarpus dacrydioides*) is developing almost at the lake's edge on a sandy silt (Fig. 5), and at Te Ngae, on a sandy loam in similar situation, an old pukatea (*Laurelia novae-zelandiae*) and white-pine forest has developed.

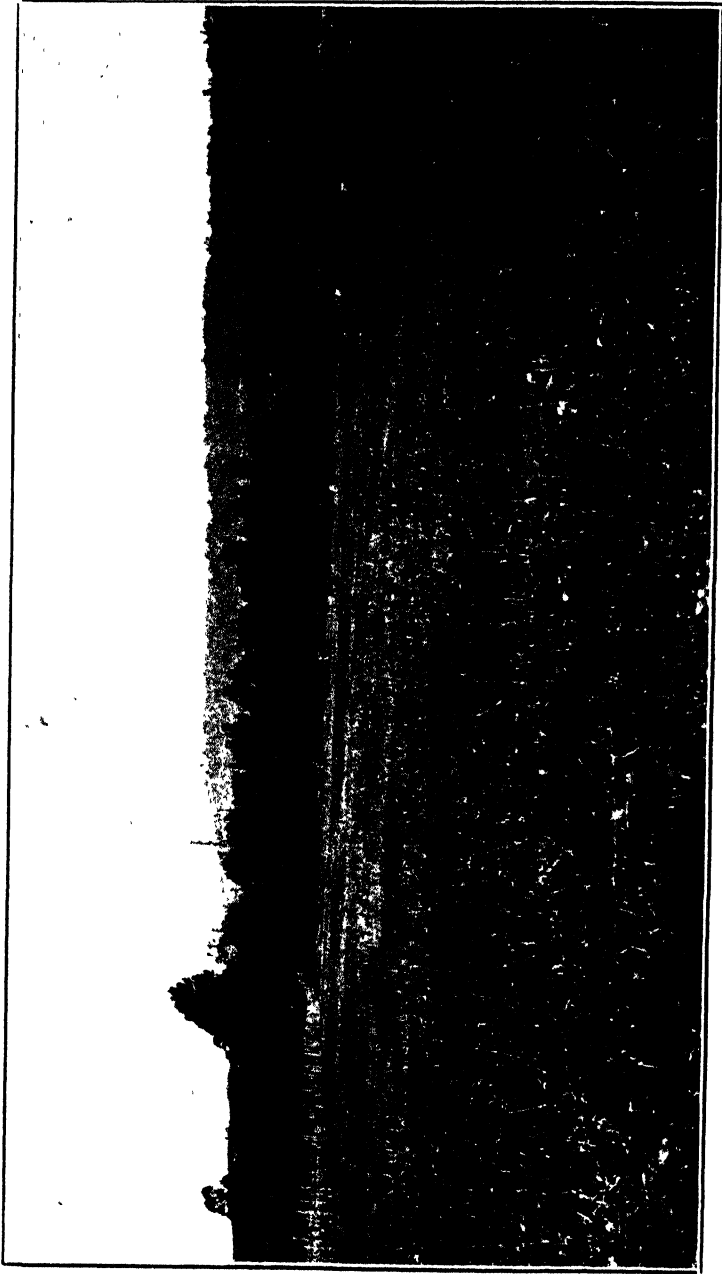


FIG. 6. TE NGAE MISSION-STATION FARM, NEAR ROTORUA.
Typical of soils D 36 5 and H 521.

TABLE 3 MECHANICAL ANALYSES.

Laboratory No.	Description of Soil. (Classification of United States Department of Agriculture, modified.)	Analysis of "Fine Earth" passing 2 mm. Sieve.						Loss on Ignition.	Stones and Gravel.	Remarks.
		Fine Gravel.	Coarse Sand.	Fine Sand.	Silt.	Fine Silt.	Clay.				Moisture.
Mamaku - Rimu-Tawa Soils										
S 173	Sandy silt	1.4	28.9	24.7	17.7	7.6	2.8	2.4	13.7	No. 4 paddock, cultivated flat. Demonstration Farm.
174	"	2.1	27.8	23.2	16.9	6.3	3.6	3.8	15.3	Unmanured 200-acre paddock, Demonstration Farm.
178	"	1.8	27.8	23.3	16.1	7.8	2.3	7.6	11.9	No. 12 (spent iron oxide) paddock, Demonstration Farm.
180	"	1.1	27.7	22.1	16.9	7.5	3.1	3.1	16.9	No. 11 (guano) paddock, Demonstration Farm. Pasture.
181	"	1.3	30.5	27.4	18.7	8.6	2.3	1.6	9.7	From rimu-tawa forest. Demonstration Farm.
182	"	1.1	30.6	26.0	17.7	8.5	1.2	3.1	11.5	From rimu-tawa forest, scenic reserve.
183	"	1.5	31.4	27.5	18.3	9.0	1.9	1.5	8.9	From windmill paddock, Demonstration Farm. Pasture.
192	Sandy loam	1.0	17.7	16.2	11.9	9.6	7.0	9.5	26.4	From rimu-tawa forest, end of Steele's tramway, near bridge. Rhyolitic soil.
S 59	"	1.2	14.7	12.4	15.5	11.3	1.8	34.0	9.5	From No. 9 (pig) paddock, rhyolitic mound, Demonstration Farm. Pasture.
C 845/9A	Sandy silt	1.2	27.7	22.1	19.7	8.9	2.9	1.8	12.9	From Martin's demonstration experiment paddock, Mamaku Pasture.
R 986, 989 S 179	Subsoil (sandy silt)	0.8	28.8	26.7	13.4	5.3	3.2	5.4	15.2	Composite sample of subsoils from railway cutting, spent-oxide paddock, and scenic reserve, Mamaku.
Mamaku "Birch" and related Soils										
S 336	Sandy loam	1.4	14.4	17.3	17.5	6.5	3.6	25.3	14.0	Birch forest, National Timber Company's cutting.
338	"	1.3	12.9	16.3	15.0	11.1	2.3	31.3	9.6	Rimu-tawa, adjoining S 336.
H 184	"	2.2	16.1	19.0	16.3	8.1	3.1	22.6	11.4	Birch forest, Gammam's cutting.
511/513	"	0.5	16.8	23.4	16.4	6.5	1.4	23.3	10.9	Composite Oturoa top soils
512/514	Sandy silt	1.6	19.4	21.3	18.0	6.5	2.2	14.8	13.3	Composite Oturoa subsoils
510/516	Sandy silt approaching a sandy loam	8.2	21.7	19.3	16.2	6.7	1.8	12.9	12.5	Oturoa Road (near school).
S 335	"	1.6	28.5	21.0	18.4	9.5	1.4	10.9	8.7	Rimu-tawa, adjoining S 336.
338	Sandy silt	1.6	28.5	21.0	18.4	9.5	1.4	10.9	8.7	Birch ridge, back of Ngongotaha, 850 ft. (Not typical birch country.)

Rotorua : Lake- <i>red</i> Soils.													
Rotorua First Terraces about Lake.													
Rotorua Upper Lake Terraces													
Rotorua East Side, influenced by 1886 Eruption Mud													
R	887	Sandy silt	7.3	31.0	21.4	14.1	11.4	3.6	2.0	8.7	7.2	Himemoa Point, east side	Rough pasture
	879	Coarse sand	8.8	38.1	22.7	8.3	6.3	2.2	1.8	12.6	17.1	Nongotaha, lakeside	Rough pasture.
	1147	Sandy silt	8.5	32.5	16.5	14.1	10.4	2.0	2.9	15.1	9.1	White-pine forest, lakeside.	Nongotaha.
H	840	Coarse sand	16.8	45.6	17.9	8.3	2.3	1.2	7.6	..	20.0	Lake-side, Rotorua	Pasture.
	482	"	17.6	41.7	12.8	15.0	3.5	1.2	8.1	..	24.1	Lake-side, Warangi East.	Pasture.
H	493	Sandy silt	2.1	21.1	18.1	15.9	3.1	1.3	25.7	12.1	1.1	Clayton Road, near Fairy Spring.	Manuka.
	495	"	1.1	14.2	29.2	15.6	3.5	1.4	24.2	12.3	0.9	Clayton Road, wet soil.	Manuka.
R	877	"	4.3	33.8	21.6	15.6	6.9	1.6	2.1	12.3	Trace	Clayton Road, poor pasture.	
	970	"	2.6	31.3	23.9	18.5	6.2	0.9	2.5	12.0	Trace	50 ft. terrace.	Pasture.
	1140	Sandy loam	1.3	18.7	21.1	23.9	11.0	3.8	3.7	16.3	Trace	River-terrace.	Pasture.
	1093	Sandy silt	3.3	29.3	25.1	20.5	5.4	1.1	2.4	11.5	Trace	Arapeutu Reserve, Whakarewarewa	Stock Road
													Manuka.
P	531	Sandy silt	0.8	23.7	28.7	21.1	8.1	1.4	14.7	14.7	Trace	Mallroy Road.	Manuka terrace.
R	949	"	2.5	28.9	25.0	18.3	7.1	1.0	2.6	12.7	Trace	Mallroy Road	Cultivated.
	932	"	2.3	29.1	24.5	18.3	5.2	0.8	5.9	12.5	4.5	Slopes of terrace 100 ft. above Whakarewarewa.	
	958	"	2.3	27.6	23.7	16.8	5.3	0.7	10.9	13.3	Trace	South of 95.2 towards Whakarewarewa.	Fern.
	982	"	3.1	33.7	23.2	16.7	5.7	0.7	2.9	11.8	"	Nongotaha hillside, 200 ft. Pasture	
	997	"	3.1	33.7	23.2	12.7	4.9	0.6	6.4	14.7	4.5	Above Nongotaha terrace above top terrace.	Fern.
	860	"	2.3	29.4	23.2	20.0	6.4	1.1	2.4	12.8	4.0	Above Nongotaha Township 175 ft. Terrace.	Pasture.
	871	"	2.1	25.0	26.1	18.8	6.3	0.8	4.1	15.4	2.7	Highest terrace in tutu and fern association.	
	873	"	2.7	27.5	21.7	18.7	7.3	1.0	5.7	14.1	3.0	Grassed land going back to fern	Hillside terrace.
	875	"	2.5	30.6	22.5	19.3	6.5	1.3	2.6	13.0	Trace	Excellent pasture paddock	Lowest terrace.
	961	"	2.0	29.0	23.2	19.5	6.5	0.8	2.9	15.4	3.0	Fern land, upper Clayton Road	Not terraced, 475 ft.
	930	(subsoil)	2.8	30.5	21.8	17.7	5.7	1.2	2.0	7.6	Trace	Hillside soil to south of R 875.	Fern.
	964	"	2.6	23.8	25.1	22.8	9.6	1.7	1.5	11.1	Trace	Subsoil of R 949	
												Upper Nongotaha River terrace.	200 ft.
												NOTE—The exact similarity of the hillside soils to the terraced soils shows that the terraces have been covered by an aerial deposit since they were formed.	
R	1102	Sandy silt	4.8	28.9	24.6	22.1	5.1	1.5	2.0	10.1	Trace	Waeroa Road, lowest paddocks	cultivated.
	881	Coarse sandy silt	14.2	35.7	17.8	12.9	7.7	2.6	1.6	6.9	24.3	Moerua hillside.	Tutu and fern
	1096	Sandy loam	5.0	16.5	26.6	18.7	13.4	5.8	2.2	9.7	5.5	Waeroa Road, 135 ft. Cultivated	
	1089	"	5.0	16.5	26.6	18.7	13.4	5.8	2.2	9.7	5.5	Waeroa Road, 135 ft. Cultivated	
H	881	"	2.8	21.6	23.4	21.7	7.9	4.1	1.4	5.4	14.4	Waeroa Road.	Cultivated.
	883	"	1.9	16.1	22.4	38.6	7.4	2.0	..	15.3	8.6	Te Ngae swampy forest (pukatea-kahukatea)	
	884	"	4.4	20.3	20.3	20.1	6.5	2.8	..	25.3	Nil	Te Ngae volcanic mud.	
R	883	"	9.1	30.4	23.2	15.9	9.3	4.4	0.0	8.6	19.0	Te Ngae river-terrace.	
	520	Sandy silt	10.6	15.9	12.8	12.4	7.6	2.7	30.0	8.0	..	Subsoil of H/519.	

TABLE 4. CHEMICAL ANALYSES.
Results, except *, are percentages on soil dried at 100° C.

Laboratory No.	Locality.	Volatile Matter.		Total Nitrogen.	1-per-cent. Citric-acid Extract, Dyer's Method, Hall's Modification ("Available" Plant-food).				Hydrochloric-acid Extract ("Total" Plant-food).				Hydrogen-ion Determination, pH Value.	Fe (Iron) Extracted by Citric Acid and by HCl	
		* On Air-drying.	* At 100° C.		Lime, CaO	Magnesia, MgO.	Potash, K ₂ O.	Phosphate, P ₂ O ₅ .	Lime, CaO.	Magnesia, MgO.	Potash, K ₂ O.	Phosphate, P ₂ O ₅ .			
Mamaku Rima-tawa Soils															
Taken at or adjoining Demonstration Farm.															
S 173	No. 4 (cultivated) paddock	..	2.42	14.04	0.287	0.145	0.014	0.014	0.011	0.22	0.13	0.08	0.02	5.7	0.118
174	200-acre grassed paddock	..	3.80	15.28	0.314	0.028	0.007	0.008	0.003	0.40	0.04	0.04	0.05	5.6	0.073
175	200-acre grassed paddock	..	32.00	12.15	0.322	0.195	0.019	0.020	0.003	0.45	0.15	0.07	0.02	5.6	0.049
176	Rhyolite dust	..	0.82	5.48	0.119	0.036	0.011	0.013	Trace	0.13	0.11	Trace	0.02	5.8	0.022
177	Rhyolite mound, No. 6 paddock	..	4.78	10.67	0.232	0.167	0.017	0.009	0.006	0.23	0.13	0.05	0.02	5.7	0.062
178	Subsoil of No. 6 paddock, No. 12	..	7.64	12.91	0.385	0.132	0.019	0.023	0.005	0.22	0.15	0.06	0.02	5.8	0.075
179	Subsoil of No. 6 paddock, No. 11	..	5.82	13.52	0.211	0.061	0.009	0.005	0.004	0.12	0.10	0.04	0.02	5.8	0.075
180	Guano paddock, No. 11	..	2.96	17.33	0.413	0.173	0.019	0.024	0.006	0.29	0.15	0.07	0.03	5.9	0.116
181	Rimu-tawa forest	..	1.61	9.02	0.222	0.120	0.032	0.015	0.004	0.44	0.15	0.07	0.01	5.6	0.072
182	Rimu-tawa scenic reserve	..	3.12	12.54	0.301	0.111	0.030	0.013	0.003	0.24	0.12	0.04	0.01	4.6	0.057
183	Windmill paddock, No. 6	..	4.46	18.99	0.230	0.135	0.015	0.020	0.005	0.21	0.13	0.06	0.02	5.5	0.100
192	Steele's new tram, near bridge	..	9.32	29.13	0.634	0.192	0.023	0.025	0.010	0.35	0.14	0.08	0.05	5.0	0.071
Mamaku "Birch" Soils.															
S 184	Birch forest, Gamman's cutting	..	31.21	13.97	0.248	0.038	0.014	0.016	0.002	0.15	0.14	0.05	0.01	4.4	0.008
185	Subsoil of 184	..	7.72	11.64	0.176	0.022	0.005	0.006	0.001	0.14	0.16	0.08	0.01	5.9	0.112
336	Birch forest, National Timber Company's cutting	29	25.46	17.34	0.322	0.045	0.011	0.011	0.003	0.17	0.13	0.11	0.01	..	0.090
338	Mixed forest, National Timber Company's cutting	30	12.94	14.36	0.357	0.087	0.015	0.017	0.005	0.28	0.17	0.16	0.05	..	0.057
335	Oturea Road, near school	..	14.82	15.75	0.381	0.155	0.021	0.024	0.007	0.33	0.20	0.09	0.03	..	0.069
Rotorua: Lake-level Soils (swampy).															
D 348/5	Ngongotaha	..	35.84	10.34	..	..	..	0.013	0.011	0.445	..	..	0.12	..	0.102
879	"	..	35.20	6.68	..	..	..	0.009	0.007	0.204	..	..	0.10	..	0.129
887	Hinemoa Point (not swampy)	..	39	1.81	12.85	0.303	0.137	0.020	0.033	0.440	0.30	0.09	0.09	5.5	0.086
1147	Ngongotaha white-pine swamp	..	22	2.02	8.88	0.036	0.027	0.013	0.013	0.620	0.260	0.18	0.05	5.8	0.051
		31	2.87	15.56	0.386	0.108	0.036	0.023	0.019	0.440	0.210	0.14	0.15	5.5	0.163

		Rotorua First Terrace above Lake.															
R		27	2-10	12 50	0 243	0-054	0-020	0-018	0-006	0-23	0-13	0-03	0-05	6-0	0-039		
877	Clayton Road	..	..	..	..	..	..	..	..	..	..	..	..	..	..
979	Ngongotaha, 50 ft.	23	2-53	11 72	0 279	0-112	0-027	0-009	0-005	0 31	0-12	0-04	0-11	6-4	0-015		
1093	Arapeiti Reserve, 80 ft.	21	2-39	11-33	0 227	0-043	0-018	0-013	0-006	0 26	0 23	0-37	0-09	..	0-024		
		Rotorua Upper Lake Terraces															
P		316	13-22	0-208	0-086	0-022	0-019	0-003	0-24	0-20	0-09	0-02	0-02	..	..
531	Maliroy Road Settlement, Rotorua	..	..	..	..	..	..	..	..	..	..	..	..	..	..
949	Maliroy Road Settlement, 50 ft.	34	2 60	13 05	0 293	0-062	0-017	0-019	0-011	0-18	0 15	0-11	0-06	6-5	0-046		
952	Maliroy Road Settlement, middle terrace, 450 ft.	25	5 90	13 04	0-253	0-058	0-027	0-018	0-007	0 20	0-19	0-08	0-09	6-5	0-033		
955	Maliroy Road Settlement, 423 ft.	..	..	..	..	..	..	..	..	..	..	..	..	..	..
958	Maliroy Road Settlement, fern slopes, 100 ft.	35	2-76	12-77	0-265	0-100	0-040	0-015	0-005	0 20	0 12	0 04	0 10	6-3	0-028		
982	Mount Ngongotaha, 200 ft. terrace	23	2-90	12 14	0-257	0-085	0-026	0-022	0-006	0 34	0 2	0 09	0 11	6-6	0-015		
991	Mount Ngongotaha, hillside	6 44	13-91	0-295	0-101	0-028	0-021	0-005	0-28	0 15	0-07	0-05	0-02	6-2	0-015		
967	Mount Ngongotaha, 175-200 ft. above township	29	2-88	13-17	0-293	0-085	0-023	0-017	0-005	0 23	0 17	0-05	0-02	6-2	0-021		
869	Maliroy Road Settlement, highest terrace	30	4-74	16-00	0-356	0-144	0-024	0-026	0-011	0-48	0 19	0-08	0-02	6-3	0-064		
871	Maliroy Road Settlement, middle terrace	29	5 66	15 00	0-279	0-131	0-037	0-028	0-012	0 33	0 16	0 07	0-06	6-3	0-032		
873	Maliroy Road Settlement, lowest terrace	34	2 86	13 30	0-282	0-081	0-034	0-013	0-006	0 22	0-14	0-05	0-04	6-3	0-033		
875	Upper Clayton Road, 475 ft.	38	2 86	15 80	0 300	0-129	0-042	0-031	0-006	0 36	0 18	0 07	0-04	6-2	0-032		
901	Upper Clayton Road, 475 ft.	..	2 46	10 85	0 304	0-058	0-023	0-018	0-006	0 20	0 19	0 03	0-04	..	0-033		
D 1121/5	Whakarewarewa (green-matured)	..	19 89	10 33	0 193	..	..	0-028	0-017	0 39	0 12	0 06	0-13	..	0-031
1121/3	Whakarewarewa (green-matured)	..	32 80	11 69	0 225	..	..	0-019	0-024	0 37	0 10	0 06	0-13	..	0-031
1121/4	Whakarewarewa ..	..	33 03	10 52	0 179	..	..	0-014	0-013	0 21	0 08	0 05	0-04	..	0-043
P 531: Lime-requirement—on air-dried soil, 0 37; on soil dried at 100° C 0 38.																	
		Rotorua East Side, influenced by 1886 Eruption Mud.															
R		17	1-98	9 93	0 197	0-068	0-027	0-017	0-007	0-48	0-16	0 14	0-08	..	0-018		
1102	Wairoa Road, low level ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
881	Nourea Village ..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1096	Wairoa Road, higher level ..	28	1 58	7 03	0-156	0-093	0-028	0-030	0-012	0-82	0-42	0 17	0-03	5-9	0-085		
1099	Wairoa Road, highest level ..	10	2 22	10 37	0 247	0-162	0-048	0-035	0-011	0 07	0-14	0 07	0-04	..	0-055		
885	Wairoa Road, low level ..	15	1-03	5 17	0 142	0-136	0-045	0-035	0-009	2 10	1-08	0-47	0-05	..	0-054		
36/7	Wairoa Road (tutu and fern) ..	31	2 44	7-32	0-153	0-128	0-034	0-023	0-005	1 25	0 6	0 24	0-05	6-5	0-032		
D 1121/5	Wairoa Road ..	..	25 45	3 44	0 146	0-146	0-034	0-024	0-031	..	..	..	0-08	..	0-184
H 810	Te Ngae, swampy forest, lake-level ..	..	13 30	2 36	0 146	0-146	0-034	0-024	0-035	0-43	0 38	0-02	0-06	..	0-304	
R 883	Te Ngae, river-terrace ..	..	13 10	4 75	0 120	0-119	0-010	0-035	0-035	1-20	0 38	0-02	0-07	..	0-320	
C 1317/14	Te Ngae, 1886 eruption mud ..	15	0-90	5 40	0 161	0-101	0-034	0-025	0-006	1 17	0 64	0 23	0-03	6-0	0-031		
D 36/5	Te Ngae, low-level paddocks ..	..	24 27	4 67	0 161	0-186	0-016	0-044	..	..	..	..	0-09	..	0-031
1121/13	Te Ngae, white-pine swamps ..	..	21 25	5 36	0 166	0-192	0-017	0-047	..	..	..	..	0-09	..	0-031
1121/14	Te Ngae, fern country, low level ..	..	23 89	3 51	0 066	..	0-020	0-025	2 05	0-76	0 11	0-05	0-05	..	0-240	
1121/15	Te Ngae, subsoil of 14 ..	..	17 76	3 09	0-096	..	0-023	0-022	1 74	0-86	0-27	0-05	0-13	0-07	0-178	
1121/16	Te Ngae, raupo swamp ..	..	21 11	9 99	0-188	..	0-037	0-011	0-05	0 32	0 13	0-07	0-21	..	0-101	
		..	28 56	20 15	0 381	..	0-043	0-063	1-25	0-46	0-21	0-20	0-43	..	1-598		

NOTES.—Sample R 887 (Rotorua lake-level soils) bears only slight evidence of having been affected by the 1886 eruption mud (see lime percentage). Series D 1121/3, 4, 5 are inserted to show the effect of ploughing in green crops at Forest Department's nursery. Series R 949/52, 55/58 is taken to the east of series R 869/71/73/75, but on the same terraces approximately.

CONCLUSIONS.

The results of analyses of typical Mamaku and Rotorua sandy silts show that they are all soils of excessively coarse texture, but that the Rotorua lake-side sandy soils are superior in water and available iron and phosphoric-acid content. The other Rotorua sandy silts have a higher hydrogen-ion figure (*i.e.*, a less acidity) than the Mamaku series, but the available and total phosphoric acid is still low enough to be regarded as deficient. The sandy loams of Rotorua are pre-eminently fertile and healthy soils. The percentage of lime (CaO) extracted by strong acid solvents is exceptionally high. This constituent probably exerts a beneficial effect in keeping the other plant-foods available. These sandy loams cannot be judged by the same standards as those applied to the sandy silts. The amount of available and total iron present is high.

A comparison of the figures given by the Rotorua and Mamaku sandy silts suggests that there is little chemical or physical difference between them. The matter must, however, be studied in connection with the climate, which may differ widely in the two districts, Mamaku being some 800 ft. above these Rotorua terraces. No meteorological records are, however, available for Mamaku. Rotorua (rainfall 40–60 in. annually) may have the advantage in climate, but this is not certain, as a greater rainfall and lower soil-temperature—conditions which may be safely credited to Mamaku—may be more beneficial to the accretion of humus in sandy silts than lower rainfall and higher temperature. Rotorua certainly has the advantage in the fact that the country has been cleared of forest by the aboriginal owners, and the lands have not had time to revert to a vegetation more woody than that of the fern or scrub stage. Hence the matter of clearing, cropping, and grassing Rotorua fern and scrub lands is a cheap and simple matter compared with breaking in the forest country of Mamaku.

Whether the same standard for iron should be applied to judge the Rotorua sandy silts as the Mamaku sandy silts is a matter which is better deferred until the other pumice series of the adjacent country are examined.

One can at present only say that these analyses emphasize the advice already given to increase the humus content and therefore the water-supply of the soil by green-manuring, and the mineral-food supply by phosphate manuring, which also increases the root-development of the plant and enables a wider area of soil to be penetrated for plant-food. Lime should not be used on sandy silts except for such crops as turnips.

All the samples taken in this survey were drawn under the writer's personal supervision in the field. The soils were taken from cultivated or grassed areas or areas under the native vegetation. They were drawn by means of a sample auger to a uniform depth of 9 in., the subsoil being taken to a further depth of 9 in. below this, and occasionally a second subsoil was taken 9 in. below the first subsoil. Several cores were taken and mixed together to represent the final sample. When present a full note of the native vegetation was taken. As before, Mr. L. D. Foster and Mr. R. E. Grimmett are responsible for the laboratory work.

IRRIGATION AND ITS PRACTICE.

(Continued.)

VI. LUCERNE-GROWING UNDER IRRIGATION.

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CENTRAL OTAGO AND LUCERNE.

ON account of its adaptability to the mica-schist soils of Central Otago lucerne has become the main irrigated crop in that district. Under irrigation, yields of 5 tons of hay per acre for the season are regularly obtained, and no great difficulty is experienced in establishing the crop. When its permanency is taken into consideration—some stands even now growing luxuriantly and yielding heavily after fifteen years' occupation of the same piece of ground—the cost of establishment must be considered quite moderate. A satisfactory feature of lucerne-growing in that semi-arid region is the fact that haymaking operations can be carried out expeditiously and with great certainty of favourable weather conditions being maintained during the process.

The importance of lucerne to the Central Otago irrigation-farmer well warrants a short account of the procedure most suited to growing the crop in that region. No attempt at a detailed description of the history of the crop and the numerous modifications of the general method here described will be attempted. Each farmer must realize that certain modifications will be required to suit his particular conditions, for even in such a comparatively limited area as is embraced by this series of articles there exist considerable variations in regard to soil and climatic factors.

SOILS ADAPTED FOR LUCERNE.

As has already been indicated, the bulk of Central Otago soils are well adapted for growing lucerne. Particularly is this so in the case of the deep alluvial deposits of mica-schist, which, overlying gravelly subsoils, make soil conditions ideal for this crop. The lighter admixtures of gravel and schist soils which exist in fairly large areas are also well adapted for the growth of lucerne, provided more frequent irrigations are given during the growing-period, and care taken to obtain suitably moist conditions for its establishment. To the uninitiated these lighter types of gravelly soils would appear to be hungry and unproductive, yet, given cultivation, moisture, and seed, striking results will in almost every case be obtained, the land previously covered with scabweed (*Raoulia*) being quickly transformed into luxuriant fields of lucerne.

Certain soils in Central Otago have a subsoil of a heavy clay nature, where free natural drainage does not exist to the degree required by lucerne. Such soils, unless drained, cannot be expected to grow good lucerne crops, the common experience of farmers being the failure of the crop after a short period. It is a recognized fact

that lucerne requires much more complete drainage of the soil than do other field-crops. Fortunately, only a comparatively small acreage of such soil exists in Central Otago, and where such is the case farmers will be well advised to establish permanent pasture in preference to lucerne. It is perhaps opportune to here mention that waterlogging of the soil through deficient under-drainage or over-irrigation rapidly leads to the destruction of lucerne. Seepage from water-races should therefore be looked to and prevented, particularly during the winter months.

Lucerne thrives best in a non-acid soil, and in its establishment lime is frequently applied to bring about such a condition. Generally speaking, the necessity for liming does not exist at present in Central Otago, and unless a farmer knows that his soil has a high lime-requirement there will in all probability be little need to carry out this operation. The application of lime, however, may be regarded as highly beneficial in general, and, where economic conditions permit of it, a dressing of approximately 1 ton per acre of carbonate of lime (raw ground limestone) is advised.

PREPARATION OF THE LAND.

On account of the smallness of lucerne-seed and the tender nature of the young plant a fine firm seed-bed is advocated. It is generally advisable to select, if possible, a piece of land which is comparatively free from weeds, or land which has grown a cleaning-crop during the preceding season. Such land is best put under the plough during the autumn, so that it will be open to the beneficial effects of the winter frosts. If ploughing is delayed later the ground may become too hard to plough satisfactorily. Deep ploughing is advised, provided too much gravel is not brought to the surface. Where only a thin layer of schist soil exists skim-ploughing should be resorted to. The land should be well worked up in the spring with a view to obtaining a fine seed-bed and preventing weed-growth. This may necessitate cross-ploughing, a double cut with disk cultivators, and double harrowing.

Too great emphasis cannot be laid on the desirability of carrying out the proper levelling of the surface of the land prior to sowing. How this is accomplished has already been described in a previous article, and it will be to the farmer's interest to put this recommendation into practice. The permanency of the lucerne crop well merits careful preparation of the land, and of all the operations which go to constitute this none will prove more economical than that of levelling. High dry spots and low oversaturated ones will thus be eliminated, and the field will be more evenly and more expeditiously irrigated. It is of importance that the preparation should be uniformly good, as poorly prepared portions are subject to failure. Such bare places form centres from which weeds may spread, particularly grasses, and these may ultimately destroy the whole stand.

TIME OF SOWING.

The months of November, December, or January are probably the most suitable for sowing lucerne. When it is sown early in the spring weeds prove extremely troublesome, particularly fat-hen

(*Chenopodium album*) and sorrel. It is of decided advantage to delay sowing until the first crop of spring weeds has germinated and has eventually been killed by cultivation. Fat-hen is not to be regarded as a very serious weed in lucerne stands in Central Otago, provided it is not too thick while the crop is in its young stage; it disappears with the cutting of the lucerne. By delaying the sowing until at least November, and keeping the ground well cultivated periodically, this trouble will be greatly diminished.

When lucerne is sown in the autumn the young plants are liable to be badly damaged by the ground "lifting" during the frosty winter months; consequently autumn sowing is not recommended.

SELECTION OF SEED.

Under no circumstances should cheap seed be sown. Such seed is likely to contain a high percentage of harmful weed impurities, and is in addition liable to be of poor germinating-power. The best seed possible should be obtained, and fresh season's seed asked for. There are many varieties of lucerne-seed on the market, but for Central Otago conditions the writers are satisfied that New-Zealand-grown Marlborough seed is very satisfactory, and consequently this variety is recommended. Much has been heard lately of the Grimm variety, but there appears to be no sound reason why this should be sown in preference to Marlborough, particularly when its price is more than double that of the latter. The main characteristic which has made Grimm's lucerne largely grown in certain parts of the United States is its capability of living through severe winters; but winter killing of lucerne does not concern us in this country. One looks forward to the production of lucerne-seed in Central Otago itself in the course of the next few years, and when such takes place locally grown seed should undoubtedly be used for the establishment of new crops.

METHODS OF SOWING.

The manner of sowing the seed will vary according to the implements at the disposal of the farmer. One thing, however, is of great importance. If the soil has not sufficient moisture to germinate the seed and allow the young plant to grow to about 4 in. in height a preliminary irrigation should be given before sowing. Irrigating after sowing is bad practice and results in the caking of the soil, with consequent poor germination.

The best method of sowing is by the ordinary grain-drill with a lucerne-seed attachment. Failing this, the seed may be sown through the manure-spout of the ordinary drill, by setting the drill to sow, say, 1 cwt. of manure, mixing the seed with 1 cwt. of basic superphosphate, and so conveying the correct mixture of manure and seed to the soil. By this method successful stands of lucerne were obtained at the Galloway Irrigation Farm. Where the drill is used great care should be taken not to sow the seed too deeply. The depth will depend somewhat on the character of the soil. Covering to $\frac{1}{2}$ in. on the heavier types of soil is usually ample, but on the lighter types, which are likely to dry out quickly, up to 1 in. is desirable. The seed should be sown at the rate of not more than 15 lb. per acre. Many quite thick stands have been obtained from sowings of as low as

10 lb., but to be on the safe side from 12 lb. to 15 lb. is advocated. The average farmer is inclined to sow lucerne-seed too deeply, which means that much of the seed sown is lost, and unless special care is taken it is well to look upon a 15 lb. seeding as the standard. The practice at Galloway is 12 lb. per acre.

Where a drill is not available, sowing can be carried out in several ways, the chief among which are the use of the "hurdy-gurdy," the "fiddle," the wheelbarrow seeder, or the hand method. Where any of these methods are adopted it is usually advisable to sow half the seed one way across the field and the other half at right angles to the line of the first sowing. The seed should then be covered with a light harrow. Probably the best harrow for this purpose is a home-made one constructed by lacing together a few long strips of wire netting side by side, attaching them to a light drawbar, and fastening a few bolts to the end of the strips. A brush harrow made of manuka or wild-irishman is also quite suitable. If the soil is inclined to be too loose it may be rolled with a light roller, although this is not generally desirable. Before sowing seed broadcast it is usually good practice to roll the field with a Cambridge roller. This firms the soil, leaves the surface rough, and makes it possible to cover the seed well by cross-harrowing.

Under irrigation conditions the sowing of lucerne in wide drills of 21 in. or 14 in. apart, as is sometimes advocated, is not recommended; it allows too much room for the intrusion of grass and other weeds, and exposes too much soil-surface to the sun and wind, causing great loss by evaporation. The intertillage of lucerne sown in this manner is an expensive and ever-recurring operation, and in view of the excellent results obtained by sowing through every coulter of the drill or broadcast there appears to be no advantage in doing otherwise with regard to irrigated lucerne.

INOCULATION.

In Central Otago, with few exceptions, artificial inoculation of the soil is unnecessary for the successful growth of lucerne. In certain localities where difficulty has been experienced in establishing a stand it is probably advisable to inoculate before sowing, but the general experience where lucerne has been growing for a number of years with every success is that inoculation is a useless expense.

There are two general methods of inoculating soil. The first and cheapest consists of spreading soil from an old and well-established field at the rate of 2 cwt. per acre. Provided the soil is not exposed to the sunlight for a length of time, nor allowed to dry, good results will probably be obtained by this method. A cloudy day is most suitable, and the soil should be harrowed in immediately after it is spread. The second method is that of using cultures for inoculating the seed. The culture is usually contained in a special bottle, and when used according to the directions the seed is inoculated with the organisms.

In certain parts of the Dominion soil-inoculation appears to be quite necessary to ensure the successful establishment of a lucerne stand. Probably, then, where inoculation does not mean much labour or expense it would be advantageous to take this precaution prior to

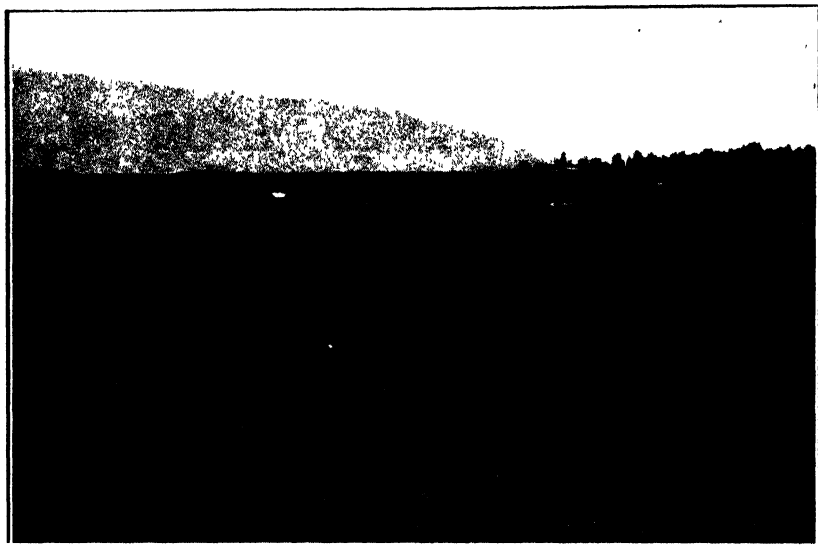


FIG. 56 STAND OF IRRIGATED LUCERNE AT TARRAS, CENTRAL OTAGO.

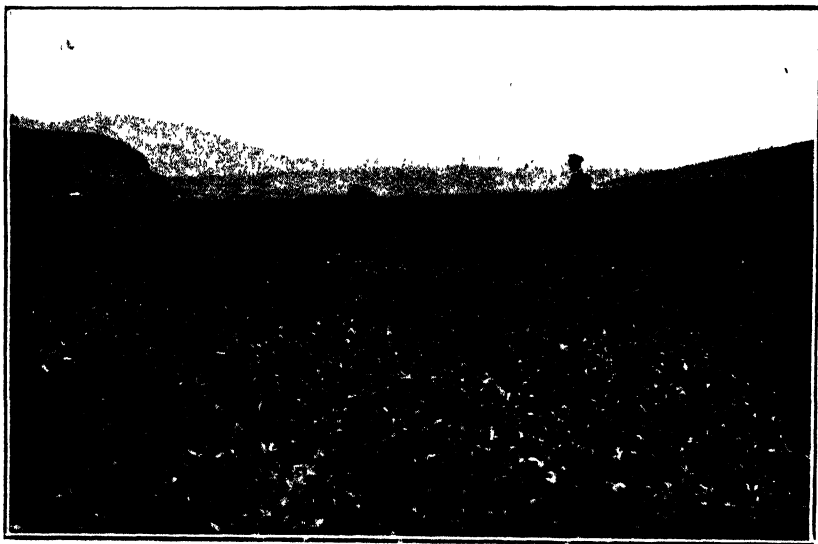


FIG. 57. ANOTHER CENTRAL OTAGO IRRIGATED STAND, AT ARDGOUR.

sowing, and thus eliminate at least one potential cause of failure when establishing stands in localities where lucerne has not been tried previously.

IRRIGATION OF LUCERNE.

The secret of successful lucerne-growing is to so regulate the number of irrigations given to the crop that at no time will the plant's growth be checked through loss of moisture. The chief considerations affecting the time of irrigation are appearance of the crop, weather conditions and evaporation, soil moisture-content, and water-supply. When the lighter portions of the field show the least sign of wilting or yellowing of the leaf it is at once an indication that irrigation is required. The moisture content of the field should be maintained in such a condition that this wilting-point will not be reached.

Generally speaking, in Central Otago a spring crop of lucerne does not require irrigation. The subsequent crops will require quite a number of irrigations, depending upon the rainfall experienced. Of all crops few respond to such a degree in direct ratio to the water supplied as does lucerne. This may be appreciated when one bears in mind the rapidity with which the plant grows, the number of cuttings produced in the one season, and the heavy green weight obtained.

It must not be assumed that incessant pouring on of water is a desirable way in which to supply the plant with moisture. In Central Otago to-day one too often sees water being applied far in excess of the needs of the crop. It is quite a common practice there to use anything from five to seven acre-feet of water during the irrigation period. Such quantities are quite unnecessary, and, in point of fact, may prove in some circumstances injurious. Until definite water-requirements for lucerne in Central Otago have been ascertained it can be assumed as a working basis, from the results of experiments elsewhere, that the maximum amount of water which should be applied during the season is in the vicinity of 30 in., although no doubt excellent results will be obtained with a lesser quantity.

Experiments conducted at the Werribee State Research Farm, Victoria, indicated that up to a limit of 48 in. of water, in addition to 16 in. of rainfall, the yield of lucerne varied directly but not proportionately to the water applied. Results obtained by the Montana Experiment Station showed that in localities having an annual rainfall of about 12 in. remarkably heavy yields could be obtained from the use of from 24 in. to 30 in. of irrigation-water, provided it was applied properly. From information collected by the Oregon Experiment Station it was ascertained that in the chief irrigated valleys of that State, where the average rainfall was 11.15 in. and the irrigation-water applied was 33.3 in., the yield of lucerne hay amounted to 5.63 tons per acre. On quite a large area of Central Otago soils, on account of the free under-drainage, it is practically impossible to irrigate lucerne to the point where decrease in yield occurs; still, once a reasonable amount of water has been reached, the proportion of increase is very slight.

The use of water, like the use of fertilizers, is subject to the law of diminishing returns. The frequency of applications to the crop will largely be regulated by the water-holding capacity of the soil. On the light soils six to eight applications of 4 in. in depth throughout

the season might be necessary. On the more retentive soils four to five applications of 6 in. at each application would probably suffice. Generally speaking, it will be necessary to irrigate from every fourteen to twenty-one days. The period of time between irrigations will be entirely dependent upon the appearance of the crop or the condition of the soil. The chief object is to maintain at all times as nearly as practicable the proper amount of moisture in the soil surrounding the roots of the plants, so as to prevent checking of growth.

The question naturally arises as to the advisability of irrigating before cutting or after cutting. Experiments in this connection show little difference; both cutting and irrigating check the growth of lucerne temporarily. If an irrigation can be given when the plant shades the ground and begins to bloom it will produce the second crop earlier. If it is decided to irrigate before cutting, this operation must be conducted several days before, in order to allow of harvesting operations. It is often asserted that irrigation prior to cutting leaves the ground in a damp condition and thus detrimentally affects the hay, in addition to lengthening the haymaking-period. That the latter drawback to this practice is quite feasible is recognized, and, quite apart from other considerations, the increasing difficulty of obtaining labour for harvesting makes it essential when once the crop is cut to have it in the stack with as little delay as possible. It must, however, be taken into consideration that if irrigation is to take place after cutting the crop must be cut on the early side, so that no loss of leaf may occur. When the crop is in the flowering stage the rate of transpiration is high. This, coupled with the low moisture content of the soil which usually prevails at that time, soon accounts for the dying-off of a large number of leaves and consequent lessening of the value of the crop. By leaving the irrigation until after cutting the danger of allowing the plant to reach wilting-point will be increased, and before the irrigation can be given a serious check will result to the following crop. The farmer will probably be guided more by practical considerations than hypothetical reasons in regard to whether he will irrigate before or after cutting.

CUTTING AND CURING.

Generally speaking, lucerne should be cut for hay when the young shoots at the base of the plants are about 1 in. in length. If these shoots are allowed to grow too long they are liable to be damaged by the mower. The flowers usually appear with the second growth, but in the spring crop cannot be regarded as a reliable guide to time of cutting. The earlier the crop is cut after coming into flower the better will be the quality of the hay for cattle and sheep.

From a haymaking point of view the general weather conditions of Central Otago are ideal. Most farmers are inclined to leave the cutting of their crop too long, and in making their hay they allow it to become too dry in the field. This results in a poor, harsh hay which does not retain the leaves, and breaks like brittle sticks in the hand. Good hay should have a nice green appearance, smell sweet, bend readily without breaking in the hand, and have an abundance of fine adhering leaves. The leaves contain about 50 per cent. of the feeding-value of lucerne hay, and are to be regarded as very valuable from a feeding point of

view. The crop should be cut in the morning of a good day for curing. In the late afternoon it should be quite ready to rake into windrows with the ordinary rake, or preferably a side-delivery rake. During the following forenoon it will most probably be fit to bunch together into rough cocks with the ordinary rake, and in the afternoon of that day it may be stacked. The hay should not be allowed to cure too long in the windrow, otherwise too many leaves will be lost in raking and handling the crop. When lucerne is raked before the leaves are entirely cured they continue to draw moisture from the stem, thereby ensuring a more uniform curing.

Occasionally the baling of lucerne hay direct from the field has been attempted in Central Otago, but this operation has rarely been satisfactory, heating taking place in the bales. It is much better practice to stack the lucerne first, and bale from the stack when it is from six to eight weeks or more in age. If heating is to be avoided in baling direct from the field the hay requires to be thoroughly cured. The result is a hard hay with loss of leaf, and rarely warrants the saving of the double handling.

One of the big drawbacks to growing lucerne in extensive areas in Central Otago is the difficulty of obtaining labour to carry out harvesting operations. The average farmer has not the capital necessary to pay the high ruling rate of harvesters' wages, nor can he reasonably be expected to have a full equipment of up-to-date labour-saving devices. By co-operative endeavour much can be done to reduce the cost of harvesting, but it is to the farmer's own benefit, particularly on the smaller farms where dairying is being conducted, to sow only sufficient lucerne to provide winter hay for the cows and horses, putting the bulk of the land under irrigated pasture.

The use of hay-sweeps and derricks certainly reduces the amount of labour in harvesting and permits the building of large stacks. These are to be preferred to small stacks, as a smaller proportion of the hay is exposed to the elements.

LUCERNE AS A PASTURE.

Irrigated lucerne is essentially a hay crop, but occasionally it is used as a pasture. The practice of depasturing an irrigated stand of lucerne, on account of the liability of cattle and sheep to become "blown," presents considerable difficulties, and great care has to be exercised to prevent hungry stock from gorging themselves rapidly. In general the grazing of irrigated lucerne is not recommended, and should be confined to either the grazing of very early spring growth or the last crop of the season. The common practice of grazing the last crop or roughage of lucerne in the autumn may be regarded as quite sound practice, provided care is taken not to graze too closely. The plants should be allowed to go into winter with some growth upon the crowns, thus enabling them to stand the winter better, and also to store up reserve food material for a vigorous growth in the following spring. Where grazing is carried out the ground should be frequently cultivated with a spring-tooth harrow to loosen up the overconsolidated soil resulting from the trampling of stock.

CULTIVATION.

Under irrigation frequent cultivation of lucerne is of great necessity. One of the commonest causes of a lucerne stand rapidly going out is the intrusion of weed plants. Of these probably the grasses are most aggressive, and it is only by repeated cultivation that their invasion can be arrested. By cultivating during the winter months at least twice with a strong spring-tooth cultivator the bulk of the weeds can be kept under control. Where it is possible a cultivation after each cutting is desirable. Not only will cultivation of this description check the growth of weeds, but its secondary effect of breaking up the consolidated soil, thus separating it and lessening the rate of evaporation, will be of great advantage in maintaining the vitality of the crop. Any damage likely to accrue from this practice may be considered as negligible in contrast with the benefits conferred on the crop.

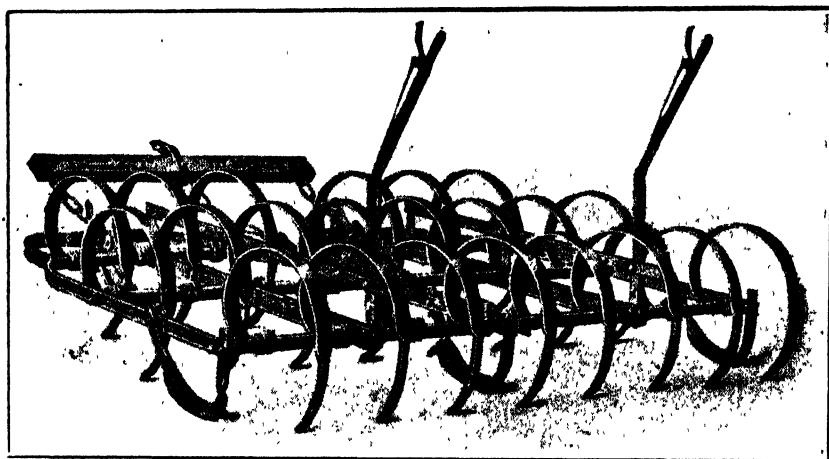


FIG. 58. SPRING-TOOTH HARROW OF TYPE SUITABLE FOR CULTIVATION OF LUCERNE.

Note the narrow teeth on the tines.

WINTER IRRIGATION.

So far the winter irrigation of lucerne has not been practised in Central Otago. In the near future, as the land becomes more closely settled and large areas of the lighter soils are brought under cultivation, it will probably be of advantage to give the land a good irrigation during the months of July or August. Winter irrigation will probably be of greater advantage on permanent pastures than on lucerne. The chief advantages of winter irrigation, apart from supplying the soil with a store of moisture, would appear to lie in the fact that lucerne is not likely to be damaged by frost, and that the mechanical condition of the soil is improved.

(To be continued.)

CONTAGIOUS PLEURO-PNEUMONIA OF CATTLE.

C. S. M. HOPKIRK, B.V.Sc. (Melb.), Veterinary Laboratory, Wallaceville.

PLEURO-PNEUMONIA is a disease of the lungs of cattle caused by a very minute organism, which, like the virus of foot-and-mouth disease, is a filter-passer. The disease was known and described as early as 1765, and since 1794 has been recognized as of a particularly contagious nature. Several commissions have made a study of the disease, which caused great loss on the Continent during its spread from Switzerland to all neighbouring States. In 1839 it passed from Holland by means of imported cattle to Ireland, and a few years later to England and the lowlands of Scotland. The United States of America also became infected from the purchase of a ship's cow as early as 1843. Later still Australia and South Africa became affected. The United States and Great Britain were able finally to eradicate the disease by slaughter of herds showing affected animals, and the trouble is now confined to Russia, Spain, Africa, Asia, and Australia. New Zealand and Tasmania, thanks to early good fortune and later to rigid quarantine arrangements, have always been free from the disease.

THE CAUSATIVE ORGANISM.

The organism causing pleuro-pneumonia is just visible with the aid of the highest power of the ultra microscope as a highly refractile spot, and until recently the exact shape was not known. However, by a special high-power photographic apparatus where exposures were made in ultra violet rays, the organism has now been found to resemble a yeast in shape and method of propagation. It has recognizable staining affinities, and was first cultivated in 1897 on artificial media by Nocard and Roux, who placed some of the lung exudate into broth in a collodion capsule and introduced the capsule into the peritoneal cavity of a rabbit. In twenty days the rabbit was killed and the broth found to be cloudy with a growth of the organism. Later this organism was cultivated in the incubator at blood-heat on solid media, and also in liquid media containing serum in a certain percentage (8 per cent.). After the liquid media had been sown, to ensure that no contaminating organisms would be found present, the whole was run through a porcelain filter. For culture purposes the organism is found pure in the lung or pleural exudate. Heat easily destroys the organism (58° C. for one hour), and cultures are found dead after one month. In ideal circumstances virulence may be retained for ten months. The lymph is attenuated considerably by air and light in three weeks, and heating at 55° C. greatly modifies the action of the organism when injected into an animal.

TRANSMISSION OF THE DISEASE.

It has been proved by experiment and careful watchfulness in the field that transmission is only by animal contact. One animal must breathe moisture and virus-laden atmosphere expired by an affected beast at a distance of, at most, only a few feet. Consequently the

disease spreads from field to field by contact of one animal with another over the boundary-fence. It is impossible to set up a typical form of the disease in any other way, and cattle which have died from pleuro-pneumonia are not a source of danger to healthy cattle on the same pasture. Contact cases take about twelve to twenty days to contract the disease.

When a young animal—which must be at least six months old, as younger animals are immune to the disease—is inoculated in the flank with a small dose of the virus-culture or lymph exudate from the lungs, after six to twenty-seven days a rise of temperature occurs and a doughy swelling appears at the seat of inoculation. The neighbouring lymph-glands become enlarged, and sometimes there is a breakdown of the centre of the swelling. If a bruising of some other part of the body has occurred there is occasionally a lesion formed in the bruised area, which rather disproves the belief that the disease is purely local in character. The lungs have never been known to become affected from any form of inoculation. Ingestion of affected material is also harmless.

SYMPTOMS.

At first the symptoms are often confused with digestive disorders, this being due to irregular rumination, capricious appetite, dull appearance, and roughened coat; but in a few days the gait of the animal changes and becomes slow and uncertain, it cannot turn without evidence of pain, percussion of the thorax causes a cough and often a peculiar moan, the pulse is accelerated and the temperature high. At a later stage the fore limbs are kept wide apart, the animal remaining still; the nose is lowered and projects in line with the neck; breathing becomes abdominal, and the cough is more frequent and usually moister. There is very often at this stage a characteristic moan during expiration, sometimes marked and at other times hardly discernible, at the nostrils. By percussion methods a line of pleural effusion can be made out in the thorax, and a zone of dullness over a large area of one side of the lungs. Sometimes both sides are affected. This dullness is due to increased density of the lung, through effusion of exudate into the lung-tissue, so that pneumonia and pleurisy are combined, as indicated by the name of the disease. Often an oedema develops beneath the chest. Abortion is a common sequel. The animal may last for ten to fifteen days, when it may die either from suffocation or of general poisoning from the disease. Should the cow live, the lesions become chronic, and the animal either survives for several weeks or gets partially well to a stage when she is a menace to all her neighbours in the herd as long as she lives. In an outbreak the symptoms as described are those usually seen, but sometimes the animal may die from a peracute form in about two days, or else, in a subacute form, linger on for weeks. In mild cases only a small rise of temperature will be present to give any indication that the animal is affected.

In a clean country where the disease has recently been introduced the death-rate is about 80 or 90 per cent., but where the trouble is old standing and precautions are taken 30 per cent. is reckoned upon.

DIAGNOSIS.

A diagnosis is based usually on a knowledge of the prevalence of the disease, the number affected in a herd, and on *post mortem* examinations of a suspected case. Pleuro-pneumonia may be mistaken for several other conditions before death, but after death the state of the lungs narrows the trouble down to one of two—hæmorrhagic septicæmia ("corn-stalk disease" of U.S.A.) and pleuro-pneumonia. These are easily differentiated with the aid of the microscope, as they are caused by totally different organisms. Seen before incision the lungs appear non-collapsed and swollen; they sink in water, and feel more or less like liver; when incised a clear straw-coloured fluid exudes and later coagulates. This cut surface has a beautiful marbled appearance, which is caused by the white streaks of connective tissue running between the lobules being greatly distended with exudate in the lymph spaces. Between these white lines are islands of various colours, some dark red, others scarlet, and others, again, muscle-coloured or pale yellow-pink. This thickened area of the lung fades off into the still active lung-tissue.

As the disease becomes chronic the solid area is enclosed in a capsule of fibrous tissue, and, if the animal survives, the piece of lung so enclosed becomes necrosed and dry owing to a shutting-off of the blood-supply. This condition is dangerous, as the area may open up at any time, and the organism of the disease appears to be ever ready to take advantage of such an opening. The position is that either the animal will get a second attack of the disease or it will act as a potential carrier for the rest of the herd. It is for this reason that any cow affected must be killed and not allowed to convalesce. Only rarely does a sloughing of the lungs occur, as the lung-lesion is so well enclosed that other organisms do not easily gain entrance, and they are seldom imprisoned in the area. On the walls of the lungs there is usually to be seen a thick creamy layer of deposit, with some 2 gallons of a clear fluid in the chest-cavity itself.

Where intramuscular inoculation of an animal is carried out for obtaining active lymph, the muscles show just such a marbling as is seen in the lungs, together with a quantity of serum which causes the doughy condition of the swelling.

There are several scientific laboratory methods of identifying the disease: (1) Cultivation in broth plus serum, after passing through a porcelain filter; (2) the agglutination test, in which the serum of an affected animal in certain dilutions has the property of causing the organisms to mass together and form a deposit on the sides and bottom of the tube; (3) the complement fixation test. The last two methods have been perfected recently by Major G. Heslop, at the Veterinary School, Melbourne. Major Heslop also keeps pure cultures in stock for the work of immunizing animals against the disease.

IMMUNIZATION.

To gain an immunity several methods are in vogue. That of Willem is the simplest. By this method a small amount of lung-lymph is taken from an animal killed while affected with an acute attack of the disease, and inoculated into the tip of the tail. The method has several drawbacks, such as the loss of tails in 5 to 15 per cent.

of cases, the transmission of other diseases, such as tuberculosis, into the inoculated animal, and sometimes death from general invasion of the perineal and pelvic regions. Immunity is established for twelve months. Pasteur, by his method, obtained lymph from an experimental animal from the inoculated area behind the shoulder, and mixed his lymph with one part of glycerine to two of lymph. This material remains effective for six weeks if kept on ice. By this method no other disease is likely to be given to the animals being immunized. Theiler, in South Africa, advocates drenching cows with either the lymph itself diluted with water or else pure culture. Many say that no immunity is established by this method. Heslop, in Australia, and many workers in France prefer to use a pure culture for tail inoculations. By this method there is little loss of tails—only 0.7 per cent. in France—and the risk of inoculating other diseases is absent. Nocard prepared a hyper-immune serum, and by giving large doses could obtain a passive immunity for eight to ten days, and even a curative action with huge doses, but this is of little practical value in the field.

CONTROL MEASURES.

In order to combat the spread of the disease in any country stringent precautions are necessary. In Victoria the regulations make it necessary for the farmer to notify the Stock Department at once by wire of such an outbreak, or even of a suspected case. The farm is at once strictly quarantined against outgoing animals, except where affected cattle are being driven to the abattoir under orders from the Veterinarian in charge. The neighbours are placed under a zenary quarantine, which necessitates them having their cattle effectively inoculated. Stock visibly affected are slaughtered at once. Others have their temperatures taken daily, and a rise of one degree acts as a death-warrant, as no animal must be allowed to recover from the disease to be a potential carrier. Occasionally the agglutination test is applied in doubtful cases on a farm where the outbreak is not typical. Cattle not affected are inoculated with culture or with lymph from the lungs, and in the zenary quarantine, so long as a death does not occur, no temperatures are taken. Quarantine lasts for thirty to sixty days from the last known case.

The very serious nature of pleuro-pneumonia will thus be seen. Were the disease to find its way into this country it might very quickly take control and spread from district to district, causing some 80 per cent. of deaths in the affected herds. The necessity for the existing restrictions on the importation of cattle into New Zealand will readily be apprehended by stockowners.

Vaginitis in Dairy Cows—In regard to the 1923-24 season the Live-stock Division reports that a considerable amount of trouble was again experienced among dairy herds from vaginitis in its various forms, often accompanied by sterility. Fortunately, although indications point otherwise, a number of the cows affected continue to hold and come into profit at the usual time, but others do not, and the loss is severe. The treatment advised by the departmental officers has been found to give satisfactory results, but, owing to failure in many cases to detect it in its early stages, the treatment has to be continued over a much longer period, and it is sometimes difficult to get farmers to conscientiously carry it out over the period necessary.

REFRIGERATION AND CHEDDAR CHEESE.

CURING, STORAGE, AND TRANSPORT.

Paper read by WALTER WRIGHT, Inspector of New Zealand Dairy Products, London, at the International Congress of Refrigeration, London, 1924.

I DESIRE it to be understood that the matter contained in this paper deals only with cheese of the Cheddar variety, and has been based upon methods adopted in the export trade of cheese from New Zealand. It will be readily understood that owing to the geographical position of New Zealand such development of trade could not have been made possible without the aid of mechanical refrigeration.

One of the most important factors in the production of Cheddar cheese of a good sound commercial quality is that of adequate control of temperature, not only as applied to the manufacturing and storage branch of the business, but also in the care of the raw material which the cheesemaker has to handle in the production of such cheese. Probably one of the weakest points in the cheesemaking industry to-day is the lack of this most essential feature in the handling of milk at the source of production—that is, the dairy farm. To enable farmers to deliver their milk to the cheese-factory in the best possible condition they must have at their command some effective system of cooling the milk, at all times having in view the desirability of reducing temperatures from blood-heat in the shortest possible time after the milk is drawn from the cow. With regard to this phase of the industry I feel that there is the need of some small but efficient type of refrigerating-machine, obtainable at a reasonably low cost to farmers, that could be run in conjunction with a direct-expansion cooler for the purpose of cooling the milk immediately it is drawn from the cow. I suggest that this is a matter worthy of the consideration of not only dairy-farmers but also of manufacturing engineers. Undoubtedly in some countries, where large quantities of milk are handled by individual farmers, there should be a market available for small machines of this type.

COLD CURING.

Although it is some twenty years since experiments were carried out at the Wisconsin Experimental Station by Babcock, Russell, Vivian, Barr, and others, the full application of the principles of cold curing of cheese is far from being a general dairy practice so far as Cheddar-cheese production to-day is concerned. This is somewhat surprising, because the initial cost of installation of mechanical refrigeration is not great, and such costs are rapidly obliterated by the saving in the loss of weight and the improved quality of the cheese so treated during the process of curing. As is well known, cheese loses considerable weight after being manufactured, but such loss is governed in extent largely by the temperature of the atmosphere to which the cheese has been submitted. It therefore follows that the lower the temperature consistent with safety and a normal ripening of cheese, the lower will be the loss caused through the evaporation of moisture.

Probably the most important feature in cold curing of cheese—say, between 45° and 50° F.—is the improvement in the flavour when compared with cheese that has been cured in curing-rooms where no satisfactory arrangements have been made for the control of summer temperatures. Experience has taught us that the cheese can be taken from the press and placed on the shelves in the curing-room, where temperatures are held between 45° and 50° F., with perfect safety so far as the ultimate condition of the cheese is concerned. Cheese cured or ripened in such temperatures have, almost without exception, been found to develop a mild clean flavour, and with increase of age is found to retain those characteristics. This indicates that at the lower range of temperature the desirable colonies of bacteria or enzymes continue their work normally, while those of the undesirable type suffer a severe check on account of the temperatures being unsuitable for the development of the undesirable flavours that develop so exceedingly when cheese is ripened at high temperatures such as those of midsummer. Like many other old-fashioned theories in the world of cheesemaking, the theory that comparatively high temperatures are necessary for the normal ripening of cheese has been entirely upset, as is illustrated by the practical results obtained by the cold curing of cheese to-day.

Respecting abnormal fermentations, cheese is so admirably adapted as food material for the development of bacteria, many kinds of which are able to produce deleterious changes in it, that the influence of temperature on the rate of such bacterial activity is a matter of considerable moment. Gassy cheese is particularly associated with high-temperature curing. Regarding body and colour, it has also been found that cheese cured at 33° to 40° F. when cut presented a perfectly solid even appearance and remained so as the curing progressed, while when cured at 60° F. the cheese were more or less open and frequently bleached, presenting a mottled appearance, which increased as time went on. Further, the experiments conducted show that through the slower ripening the cold-cured cheese keeps in good condition much longer than that where rapid ripening takes place under higher temperatures—a fact of considerable importance to the cheese-dealer who may have to carry the cheese for some time. A bacteriological examination of cheese held in cold store fourteen and seventeen months showed, when the cheese was removed from cold storage, that lactic-acid-producing forms and inert species were most abundant; very few liquefying and no gas-producing organisms were found. (Bulletin 94, Agricultural Experiment Station, Wisconsin.)

The benefits of the application of cold curing of cheese can be summed up as follows: (1.) It delays the curing not more than a week or ten days. (2.) It effects a direct gain by saving from 1 per cent. to 1½ per cent. in the shrinkage of cheeses that have not been paraffined during the period of curing. (3.) It eliminates the heated flavour and mealy texture that are characteristic of all ordinary cured cheese in hot weather. (4.) It tends to prevent the development of undesirable flavours in many cheeses which would otherwise be very inferior on that account. (5.) It protects the cheesemaker in some measure from merchants' claims arising from causes over which he has no control. (6.) Cheese which has been properly cold-cured does

not require subsequent storage at extremely low temperatures to check the injurious processes which are set up by high temperatures, but may be kept in good condition with that nutty flavour essential to Cheddar cheese. (7.) The general improvement in the quality increases the consumption of cheese enormously, and, by thus increasing the demand, ensures a better average price. (Report of the Dairy Commissioner, Canada, 1906.)

It will be noted that both the authorities quoted appear to be entirely in accord as regards the benefits to be derived from the policy of cold curing. In New Zealand to-day the tendency is to take an intermediate course by adopting a temperature of from 45° to 50° F. for the curing-room—a practice that is giving good results, and, so far as my investigations have gone, this system is working quite satisfactorily and beneficially. It has to be realized that when cheese has been submitted to the ill effects of high temperature its quality suffers irreparable injury, which can only result in disappointment to the maker, financial loss to the owner, and dissatisfaction on the part of the buyer. Where such damage has taken place I know of no practicable steps that could be taken to eliminate the injury that the quality of the cheese has sustained.

It is most important that all vehicles for the conveyance of cheese from curing-room to cold store should be in such a condition as to prevent any damage to the condition or quality of the cheese during transit. Not infrequently this is a stage in the handling of cheese where it sustains damage owing to the lack of proper control of high temperatures.

COLD STORAGE.

In regard to the cold storage of cheese it has been found that the wet-battery system gives the best results, with air-temperatures in the chambers held at between 40° and 50° F. for short storage. For long storage, however, temperatures can be reduced with safety to 36° and give satisfactory results. Holding cheese at about this temperature has proved to be beneficial in that it retards the development of mites and moulds very materially. To ensure the safe and satisfactory cold storage of cheese packed in cases it might be well to mention here a few of the essential points that must be observed if results are to be satisfactory.

(1.) It is most important that the cheese should be in a fit condition for packing. The cheese should be at least fourteen days on the shelves of the curing-room, or longer if necessary, so that the rinds and tops and bottoms of the cheese may become dry and firm. To enable this to be done it is necessary that the cheese should be turned once every day during this period. If the cheese is packed before that time there is the danger that it will not stand any length of cold storage satisfactorily. There is a probability of the cheese turning out in bad condition, particularly on the tops and bottoms, because, if the rinds of the cheese are moist and soft at the time of packing, and it is placed in cold storage in that condition, putrefaction will eventually develop at the points of contact between the cheese and timber. The result is that if held for any lengthy period without attention such portions of the cheese will eventually become unfit for human consumption.

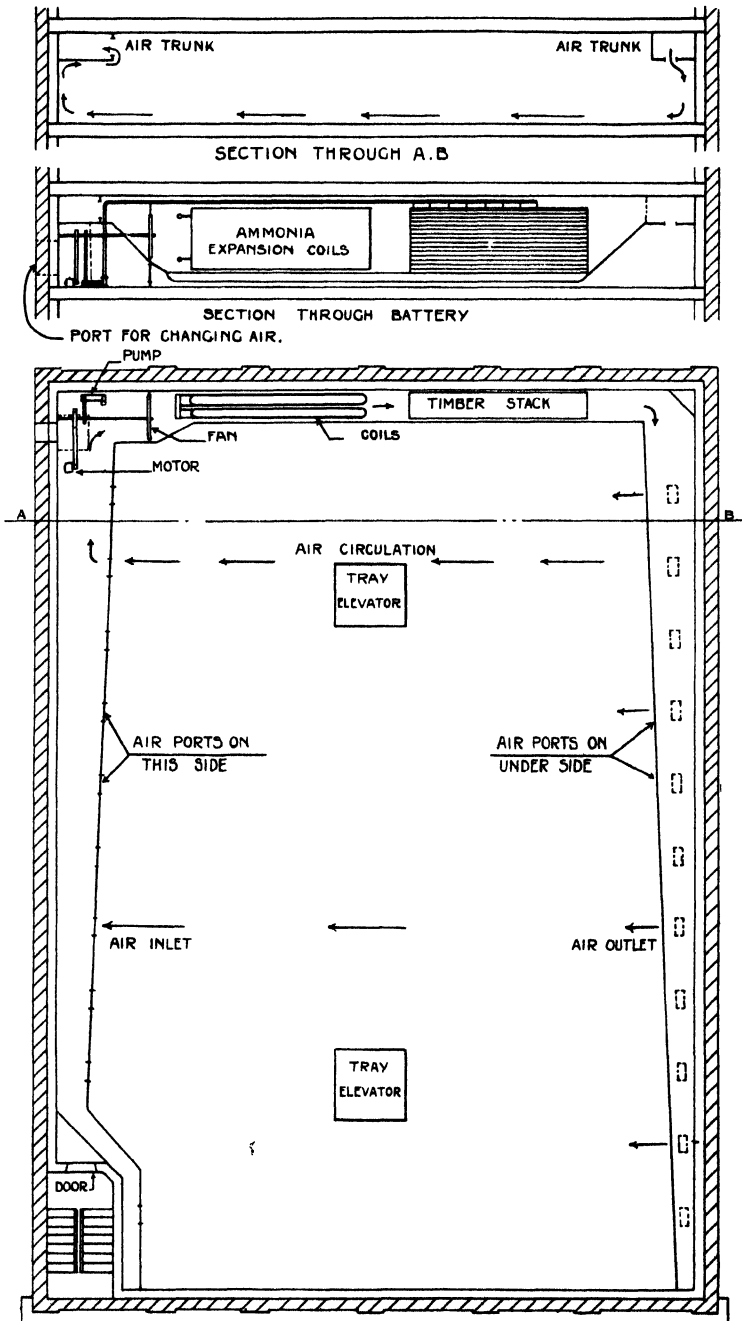
(2.) It is imperative that no cheese should be stored away in any but dry and thoroughly seasoned packages, and scale-boards should always be used. If this safeguard is neglected and the cheese is packed in green and wet timber the condition of the cheese will be found on being withdrawn from storage to be unsatisfactory, owing to the crowns having become soft and pappy and in a more or less state of decomposition, according to the time the cheese has been held in cold storage and the degree of moisture to which it has been subjected.

(3.) The question of an efficient air-circulation in the chambers has to be considered. To obtain satisfactory results all chambers require to be fitted with trunks to take the air as drawn from the battery by the fan to the several points. A system that provides trunking, with delivery-ports on one side and outlet on the other or return side of the chamber, has been found to give good results. From experiments and experience it has been found that it is better to have a large circulating-fan, thus moving the air at a comparatively slow velocity, but at the same time sufficient to keep the air moving, than it is to use a small fan driven at increased speed moving the air at a high velocity. The latter method has a tendency to crack the rinds and dry out the cheese, as it practically subjects it to what might be termed a "forced draught" treatment.

(4.) A proper adjustment of the air-delivery ports is most important, and requires frequent attention so as to provide an equable discharge of air-currents. Whatever the speed of air delivered from the various ports may be, it is advisable to use baffle-boards when the cheese is stacked close to and in direct line with the air-delivery, so as to prevent the drying-out of the cheese on which the direct air-current would otherwise impinge. Where large quantities of cheese are stored the use of large canvas screens is beneficial in the gangways between the stacks for deflecting the air-circulation through the stacks of cheese. This assists in keeping temperatures more uniform in large chambers that are filled with cheese. Temperatures are found to be irregular when there is no adequate air-circulation. Air-circulation also carries off any excess moisture there might be in the chamber.

(5.) The humidity of air can be governed, within certain limits, by the density of calcium-chloride brine that is running over the direct-expansion coils of the battery. If the air is allowed to become too dry considerable loss in weight will take place, and cracked rinds will also be the result. On the other hand, too heavy moisture will cause heavy condensation to settle upon the cheese, which, if allowed to continue for any length of time, will cause decomposition, commencing on the outside of the cheese and working inwards. Cheese submitted to such conditions will, in the space of a few weeks, begin to show decomposition, particularly on the crowns or tops and bottoms of the individual cheeses.

(6.) With reference to adequate cooling-power in the matter of cheese storage, herewith is presented a plan of the first, second, and third floors of the cheese-store of the Auckland Farmers' Freezing Company. These rooms form part of and are attached to a large block of buildings owned by the same company, and used for the storage of butter, cheese, fruit, &c., and for the manufacture of clear can ice. Each of the three stories forms one large self-contained storeroom



ARRANGEMENT OF ROOMS FOR CHEESE-CHILLING AT THE AUCKLAND FARMERS' FREEZING COMPANY'S COLD STORES, KING'S WHARF, AUCKLAND.

The first, second, and third floors of the cheese-store are fitted on this plan.

containing 66,000 cubic feet of space, each room being provided with an independent battery for cooling and purifying the air, together with the necessary air-trunks.

The building is of brick, plastered on the outside, four stories high, and roofed with asbestos tiles. The insulation of the walls is 12 in. of calcined pumice contained between the brickwork and a 6 in. by 1 in. tongued and grooved lining nailed to 6 in. by 2 in. studs, the face of the studs being 12 in. from the brick wall. Between the brickwork and pumice and between the lining and the pumice is a layer of hard felt, $\frac{1}{8}$ in. thick, saturated with bitumen. This serves a double purpose - to prevent moisture getting into the pumice, and to retard air-filtration, which also carries moisture into the insulation.

The floors and ceiling are all insulated with 12 in. of pumice filled in between the joists. Bituminous felt is stretched on the under-side of the joists before the 6 in. by 1 in. tongued and grooved ceiling-boards are nailed up, and the pumice is then filled into the space between the joists and flush with the top; another layer of felt is put over this before the flooring-boards are nailed down.

All crates and cases are taken up or brought down by swinging-tray elevators capable of handling thirty crates per minute. These are fitted with loading and discharging grids on each floor, so that the cheese can be transferred from any floor to any other at this rate. Roller chutes are also used to a considerable extent.

The refrigerating plant for each room consists of 2,400 ft. of $1\frac{1}{4}$ in. ammonia piping in two coils. These coils stand in a steel tank 12 in. deep. Beyond the coils in the direction in which the air flows is a "stack" of battens on edge, or corrugated galvanized iron on end. Chloride-of-calcium brine is drawn from the tank by a centrifugal pump, and discharged in a shower by suitable sprinklers over the expansion-coils and stack. Ammonia is expanding in the coils and cooling the brine as it runs over the coils; this cold brine on being showered over the stack further reduces the temperature of the air which comes in contact with it.

At the inlet end of the battery is a propeller fan having a theoretical capacity of 30,000 cubic feet of free air per minute, but in actual practice the amount is very much less than this. It is estimated that the air in the chambers is circulated about fifteen to twenty times per hour. (In more recent practice the fan is placed at the outlet end of the battery and the air drawn through the coils and stack.) The fan and pump are driven by a suitable electric motor.

In connection with this system it is necessary to provide some means of concentrating the brine, as any moisture evaporating from the cheese is condensed in the battery and increases the volume of the brine, and, of course, weakens it. In concentrating the liquid by boiling, the characteristic flavours of cheese are driven off and the brine purified, but there is a limit to the extent to which this can be carried out, as in time the brine becomes "sick" and must be renewed. By increasing or decreasing the density of the brine the humidity of the air in the chamber can be controlled within certain limits. The density of the brine should be maintained at a point at which it will not freeze on the coils, and which will maintain a percentage of humidity suitable for the cheese during storage. This

method of cooling and washing the air at the same time keeps the air in the chambers in a clean, sweet, and dry condition. The reason for circulating such a large volume of air per minute is that it eliminates great differences in temperature. In this plant the greatest difference of temperature in the battery and storeroom does not exceed two degrees Fahrenheit.

The Auckland Farmers' Company has freezing and chilling rooms with a total capacity of nearly two million cubic feet, operated with air-circulation and wet battery. In one case the battery contains 52,000 ft. of 1½ in. piping. For these details I am indebted to Mr. T. Simpson, managing director of the company.

(7.) My experience has been that the amount of gas thrown off by the cheese during the early stages of cold storage is governed very largely by the temperature of the cheese when it is first placed in cold store. The higher the temperature of the cheese at that time the greater will be the exudation of carbon dioxide.

Mr. F. W. Grainger, then manager, West Coast Refrigerating Company, Pateta, New Zealand, supplies the following notes regarding the storage of cheese at his company's works :—

"Cheese in cold storage gives off a considerable amount of gas, which in time makes the chambers very foul. This must be got rid of by blowing out the chambers through special outlet-ports, and taking in fresh air at the inlet end of the cooler. But we find by boiling our brine, taking a portion from each of the coolers every day for concentrating, thus getting rid of moisture taken up by the calcium chloride, and keeping the brine-density constant and adding the fresh concentrated brine, that we eliminate the gases as they are taken up in the calcium chloride and got rid of by boiling. This, in my opinion, is better than adding humid air from the atmosphere, as the latter tends to assist mould-growth on the cheese. The brine-circulating pump is fitted with a suitable bypass connection for taking out weak brine and delivering it to the concentrator, and for returning concentrated brine to replace the quantity taken out. It is an important point to make sure that brine is the right density, and to ensure an even flow over the coils so that they do not freeze over with a coating of ice, in which case the efficiency of the cooler will be lost."

OCEAN TRANSPORT.

Shipping companies in the New Zealand trade have not yet adopted a uniform system of refrigeration on board the various vessels as far as the carrying of cheese cargoes is concerned. The systems in use might be briefly described as follows: (1) Brine-circulation; (2) air-circulation from expansion batteries; (3) air-circulation from side grids. The following examples afford a brief description of the arrangement of the pipes and the fitting up of the various chambers :—

Brine-circulation: Capacity of chamber, 37,100 cubic feet; pipe measurement used, approximately 3,700 ft. run over piping 2 in. O.D.; insulation used, silicate cotton. The method of brine refrigeration is that cold brine of a suitable temperature for maintaining the required temperatures in the cheese-chambers is pumped continuously through brine-piping, being arranged in the form of grids and secured to the sides, bulkheads, and roof of the chamber. The feet-run and

disposition of the piping used is adjusted by the engineer, who can control the circulation from the refrigerating-machinery room to suit the conditions in the cheese-chambers. In this style of chamber no arrangements are made for air-circulation. The insulation used varies in different vessels, and charcoal, silicate cotton, and granulated cork are all good insulating-materials, the latter, however, having been used in all the later vessels.

Air-circulation from expansion batteries: Capacity of chamber, 27,800 cubic feet; insulation used, charcoal; air-circulation per hour, 3,000,000 cubic feet for two fans; size of fan (2 off), 5 ft.; fan-revolutions, 300. The cheese-chamber referred to under this heading is one of six cargo-spaces, having a total cubic capacity of about 285,000 ft., and the vessel is fitted with two ammonia expansion batteries and two fans, one for each battery. The practice is with a full cargo of frozen meat and dairy-produce to work both fans and batteries, although one installation—that is, one fan and one battery—is sufficient to maintain required temperatures in all insulated chambers.

Air-circulation from side grids: Capacity of chamber, 34,312 cubic feet; insulation used, granulated cork; air-circulation per hour, 300,000 cubic feet; size of fan, 20 in. sirocco. The arrangement of this system of refrigeration consists of converting the brine-grids on the sides and bulkheads of the chamber into an air battery by fitting planed boards in portable sections in front of the grids, forming a 12-in.-wide air-duct all round the sides and ends of the cheese-space. A series of air-holes are cut in the wooden shutters, and the sirocco fan circulates the air across the chamber, the suction being at one side and the delivery at the opposite side; the 20 in. fan is used exclusively for the chamber referred to. Details of these systems are from Messrs. William Replen, Son, and Swinston, refrigerating engineers, London.

The successful carriage of cheese in ocean steamers is governed very largely by the condition and temperature of the cheese when being shipped, and, from personal observations, I am of the opinion that the temperature of cheese intended for long-distance transport should be reduced to approximately carrying temperatures before being placed on board ship. If it were possible to carry out the same methods of observation and control on board ship as are adopted in cold store on land, precooling would not be so important; but as such is not possible it is essential that cheese-temperatures be comparatively low in the first instance if the best possible results are to be obtained. Before passing on I would like to record my opinion that at no period during the life of cheese, from the time of manufacture until it reaches the retailer's shop, should there be any need for precooling, because at every stage of its life the temperature should be controlled right along the line. It should be remembered that in the transport of cheese it is not possible to use a treatment similar to that adopted with frozen produce. Frozen produce is delivered on board ship in a frozen condition, and all that the steamship people are required to do is to hold the produce at the requisite temperature.

Experience has taught us that the higher the temperature of the cheese when taken on board the greater are the difficulties that

engineers have to contend with, and the most careful and watchful manipulation of the cooling-system becomes necessary. The higher the temperature of the cheese the longer will be the time before the air of the hold can be reduced to the required temperature, say, 40° to 45° F., or the figure that may be stipulated by shippers, owing to the danger of creating undue condensation, which, settling on the cheese, brings about rapid deterioration in the condition of the cargo. Taking, for instance, a shipment of cheese at an average temperature of, say, 60° to 65° F., it will be some nineteen to twenty-one days before the air in the hold can be reduced with safety to the temperature required.

Under such conditions it will be easily understood that in addition to the deterioration in condition of the cheese the quality is likewise seriously affected, owing to the rapid ripening process and the undesirable development of ill flavours common to high temperatures. At the same time such conditions favour the growth of gas-forming bacteria, which adversely affect the texture of the cheese by causing the formation of gas and other holes or openings of various types, and at the same time bring about a looseness of texture, all of which are most undesirable in cheese of the Cheddar type.

In the stowing of cheese in the holds it is important that there should be no dripping of moisture from the brine-pipes or trays overhead. Personally, I do not recommend the use of overhead grids in the transport of cheese, owing to the danger there is of damaging the cheese that may be carried underneath. It is also important that there should be a clear space of, say, 12 in. between the side grids and timbers, and false bulkheads should be carried from the ceiling to the deck of the hold so that no cheese can be stowed underneath the grids or scuppers, the latter being erected to carry off the moisture from the brine-pipes. In cases where these precautions have not been taken certain quantities are not infrequently landed in a more or less damaged condition. Until quite recently the common practice has been to carry cheese in the 'tween-decks of the vessels, but owing to the great increase in the quantity it has also become necessary to carry it in the lower holds, and results have been, on the whole, fairly satisfactory.

With regard to the temperature in the cheese-holds, I have found by experience that temperatures in different parts of the hold are variable. For instance, taking a cheese-chamber in which the depth of the hold will allow the cheese to be stacked, say, from eight to ten tiers high, I have repeatedly found that the temperatures rise approximately one degree for each tier in the elevation. This I believe to be caused through the lack of efficient power for the complete circulation of air in the holds.

In conclusion, I desire to emphasize that it is just as important to have efficient air-circulation in the cheese-holds on board ship as it is in the cold stores, because efficient air-circulation means uniform temperatures, and also, what is probably as equally important on board ship, the drawing-off of carbon-dioxide gas when heated cargoes have been taken on board.

STRATFORD DEMONSTRATION FARM.

NOTES ON OPERATIONS.

J. W. DEEM, Instructor in Agriculture and Supervisor of Subsidized Demonstration Farms.

OPERATIONS at the Stratford Demonstration Farm continue to progress steadily, stumping and general improvements being carried out as fast as finance permits. Of the total area of 143 acres, over 100 acres have now been stumped and about 90 acres sown down to new pasture. Tree plantations and hedges have made good growth and now afford considerable shelter.

PASTURES.

The practice of building up fertility by turning under green crops is now receiving attention, the procedure being to sow a temporary mixture of 30 lb. of Italian rye-grass and 6 lb. of red clover, feed this for a year, and then turn under a rich growth of green material, mostly clover. This greatly improves the humus and mechanical condition of the land, and better permanent pastures may be expected as a result.

The best pastures on this farm are sown in November. Budda kale, 1 lb., is drilled in with basic super, 1 cwt.; the land is then rolled and the grass-seed broadcasted. Various mixtures and weights of seeding have been tested, and on the average the following mixture has given the best results: Cocksfoot, 12 lb.; perennial rye-grass, 16 lb.; Italian rye-grass, 4 lb.; timothy, 3 lb.; dogstail, 2 lb.; cow-grass, 3 lb.; white clover, 2 lb.; total, 42 lb. per acre. Akaroa, local, and imported Danish cocksfoot have been tried against one another; so far we cannot see any difference; but this work is being continued. Imported white clover is also being tested against colonial and imported Dutch, but it is too early as yet to form any conclusions.

Various manures have been tested for top-dressing, and the results up to the present indicate that basic slag is decidedly the best for Stratford conditions, basic super and mixtures of lime and super coming next. The tests with Nauru rock phosphate indicate that the material is slow-acting, it being the second year before any noticeable improvement can be seen. Dressings of all manures have varied from 2 cwt. to 6 cwt. per acre. At present we are inclined to favour 3 cwt. the first year, and 2 cwt. per year afterwards, results so far indicating that a medium dressing each year is superior to a heavy dressing at long intervals. This is in keeping with the general results in Taranaki. So far neither nitrogenous nor potassic manures have shown any beneficial results when used on this farm. Kainit in conjunction with basic slag is being further tested this year.

ROOT CROPS.

Areas of turnips, swedes, mangolds, and carrots have been sown each year. The average yields per acre for the last six years are: Turnips, 40 tons 3 cwt.; swedes, 39 tons 1 cwt.; mangolds, 43 tons 11 cwt.; carrots, 31 tons 13 cwt. The best average for any one year has been: Turnips, 45 tons 9 cwt.; swedes, 43 tons 7 cwt.; mangolds, 52 tons 10 cwt.; carrots, 42 tons 12 cwt.

Individual varieties have given much heavier crops. Varieties that have given best results are: Mangolds—Prizewinner, White Sugar, and Red Intermediate; carrots—Matchless White and Sinclair's Champion; turnips—Red Paragon, Hardy, and Imperial Green Globe; swedes—Vilmorin's White Purple-top, Grandmaster, and Superlative.

Each year it is becoming more difficult to grow swedes owing to the ravages of dry-rot and club-root, and unless there is an improvement it will not be long before the growing of swedes is discontinued. A number of new varieties are tested each year, and so far Vilmorin's White Purple-top stands out as a rot-resister, but unfortunately supplies of seed are not available at present.

GREEN CROPS.

Mixtures of cereals and tares or peas are grown from time to time, mostly for hay. In view, however, of the difficulty of growing soft turnips, various varieties of peas for feeding green in the autumn are being tested.

LUCERNE.

Owing to the heavy average rainfall experienced at Stratford lucerne does not do its best there, it being difficult to keep stands free from grass and weeds. A small test area was sown in January, 1921, part with manure and part without; various systems of sowing were also adopted. The following table, giving the green weight yields of six cuts, from 1921 to 1924, presents several features of interest. The manure consisted of basic slag at 3 cwt. per acre applied at time of sowing. The area was also limed, one-half with carbonate at 12 cwt., and the other half with burnt lime at 6 cwt., per acre, but no difference is noticeable between these two parts.

Date of Cuts.	21 in. Drills. No Manure.	21 in. Drills. Manure.	14 in. Drills. No Manure.	14 in. Drills. Manure.	7 in. Drills. No Manure.	7 in. Drills. Manure.	Broadcast. Manure.
<i>Grimm Variety.</i>							
	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.
21/11/21 ..	..	4 19 96	..	..	..	..	..
13/1/22 ..	..	5 2 96	..	..	..	..	..
18/1/23 ..	..	6 15 0	..	..	..	..	..
19/3/23 ..	..	3 17 0	..	..	..	..	..
23/11/23 ..	..	5 2 84	..	..	..	..	..
14/1/24 ..	..	3 4 28	..	..	..	..	..
Total weight per acre (green)	..	29 1 80	..	..	..	..	..
<i>Marlborough Variety.</i>							
	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.	T. c. lb.
21/11/21 ..	5 2 72	5 12 56	5 19 0	6 8 64	4 16 38	6 15 0	4 16 0
13/1/22 ..	5 12 56	5 19 0	5 9 32	7 1 48	4 10 0	9 0 0	4 19 72
18/1/23 ..	7 7 84	8 3 84	6 18 0	8 16 84	7 7 84	11 11 28	6 8 56
19/3/23 ..	4 13 0	5 2 84	3 10 56	5 2 84	4 0 28	5 9 28	3 10 56
23/11/23 ..	4 16 28	5 9 28	6 2 0	6 15 0	4 3 56	7 7 84	5 6 0
14/1/24 ..	3 10 56	4 10 0	4 3 0	4 16 28	3 1 0	3 6 0	3 4 28
Total weights per acre (green)	31 2 72	34 17 28	32 1 88	39 0 84	27 18 94	43 9 28	28 4 100

Total for three manured areas, 117 tons 7 cwt. 28 lb.; total for three non-manured areas, 91 tons 3 cwt. 30 lb.; difference in favour of manure, 26 tons 3 cwt. 110 lb., or 29.34 per cent.

It will be noticed that the method of 7 in. drills, and manuring according to the Department's recommendations, resulted in the heaviest

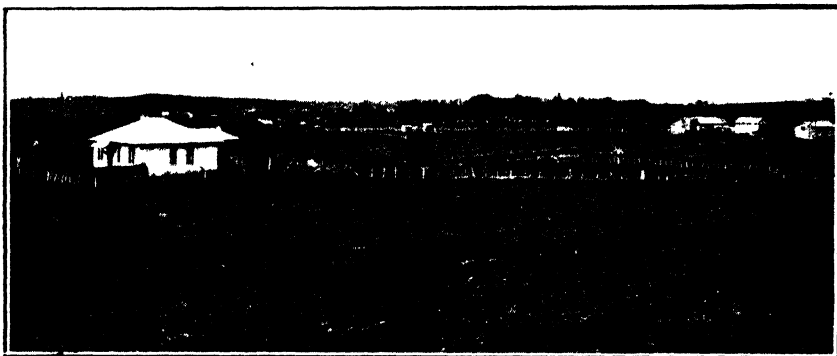
yield. Although the results generally are fair, we are not yet sure that it pays to grow lucerne at Stratford.

THE DAIRY HERD.

The herd is gradually being improved by the use of a good sire and better feeding. A considerable number of the cows now in profit were bred on the farm. The following figures give some indication of the improved returns :—

Year.			Average Butterfat Production per Cow. lb.	Average Butterfat Production per Acre. lb.
1919-20	..	..	221.10	60.8
1923-24	..	..	305.0	108.9

Both factors mentioned have helped towards this increase, but better feeding has been responsible for most of it.



VIEW AT STRATFORD DEMONSTRATION FARM, SHOWING LAND CLEARED OF STUMPS.

The milking-shed and other farm buildings are seen on right, and the homestead on left.

[Photo by E. B. Levy.

GENERAL.

The results obtained at the farm and published at some length by the district papers are carefully followed by a large number of farmers. Field-days are held at the farm from time to time, and these are attended by numbers of farmers from various parts of Taranaki. Also, the farm being always open, interested persons drop in from time to time to view the work and have a chat on farm matters, the manager, Mr. Hartwig, being always glad to see visitors. On field-days the committee attend in force. They also meet on the second Wednesday in every month, and generally two or three members, including the chairman, visit the farm in the afternoon for the purpose of reviewing the farm-work and meeting any people who care to attend. Some of our visitors make the criticism that we are not doing enough experimental work, but the policy of the Farm Society is more demonstrational than experimental. There is no doubt that a great deal more could be done if money was available, but as our income must be earned before it can be spent we can only advance at a moderate pace.

FIELD EXPERIMENTS AT HILLERSDEN.

LUCERNE AND PASTURE ESTABLISHMENT.

F. W. GREENWOOD, B.A., Instructor in Agriculture, Blenheim.

FOR the past year or two co-operative experimental work has been in progress on two farms in the Hillersden district, Upper Wairau Valley—on those of Mr. D. Black and Mr. A. Bishell respectively. An inspection of the plots was made on the occasion of a field-day held in October last, when observations were recorded as below.

LUCERNE.

The experiments on Mr. Black's property deal with lucerne-culture. The lucerne in question was sown on 16th November, 1923, with Marlborough-grown seed, at the rate of 14 lb. per acre. Where inoculation was used, Farmogerm bacterial culture, mixed with moist soil, was employed. This method of inoculation is not usually practised, it being more usual to treat the lucerne-seed with Farmogerm. Where manure was employed it consisted of 1 cwt. of a mixture composed of $\frac{1}{2}$ cwt. blood-and-bone and $\frac{1}{2}$ cwt. superphosphate. Lime, when used, was applied at the rate of 1 ton per acre during the winter previous to sowing.

For those not well acquainted with Wairau Valley soil-conditions it may be explained that while on the lower reaches of the plain the soil ranks with the best in the Dominion, Hillersden is situated at the upper or western end of the valley, where the soils have been subjected to much erosion in the past through river-action. Consequently Hillersden soils generally are fairly poor, and markedly deficient in lime. The typical flats of the district consist of a clay loam with a fair admixture of stones and shingle. Such soils as these, it will be at once seen, present various difficulties where lucerne-establishment is concerned.

The experimental plots, working from east to west, are as follows: No. 1, limed, manured, and inoculated; No. 2, manured and inoculated; No. 3, limed and manured; No. 4, limed and inoculated; No. 5, limed only; No. 6, manured only; No. 7, inoculated only; No. 8, control plot—no inoculation, lime, nor manure.

From a comparative standpoint these plots provided most instructive results. No. 1 was of a rich dark-green colour, the lucerne being of uniform growth and fully 5 in. or 6 in. higher than that on Plot 2. This might lead one to suppose that lime had in this instance been a controlling factor. In Plot 2 the lucerne was uniformly developed, but the growth somewhat stunted. On Plot 3 the darker green colour, due to the presence of lime, was more in evidence than on Plot 2. Plot 4, which had been both limed and inoculated, while not quite as forward as Plot 1 (treated with lime, inoculation, and manure), was yet easily the second best. Plot 5, on which lime alone was employed, was distinctly inferior to Plot 4, but much better than Plots 6 and 7, on which manure alone and inoculation alone had been respectively employed. No. 8, the control plot, was easily the worst plot on the field.

Distinctions were so pronounced on these plots that it took no verbal argument to convince those present at the demonstration of the combined efficiency of liming, inoculation, and manuring. To many New Zealand farmers these truths may be considered timeworn. It may be pointed out, however, that on the lower portions of the Wairau Plain usually little result is obtained from artificial inoculation, the lucerne bacteria being already largely present in the Blenheim soils. Again, on the papa-country of the Awatere district the relatively high lime-percentage in the soil (at Kaparu ranging from 17 to 25 per cent.) makes lucerne-growing easy. The same is true of the limestone and papa country at Ward. The sea-beaches at Kekerangu, where the salt content is not excessive, and where pulverized shells exist in abundance, also provide favourable conditions. With the last-named soils, it might be mentioned, it is a good plan to sow marram-grass to stop the sand-drifts, and then sow lucerne among the clumps of marram.

As compared with the conditions of all these latter localities those at Hillersden are comparatively very unfavourable. The soil, as already indicated, has been largely denuded, and has had much of its lime washed out and carried down on to the lower plains. Generally speaking, it may be said that lucerne is not only more difficult to grow in Hillersden, but more expensive to maintain when it is grown. Lime delivered on a Hillersden farm costs in the vicinity of £2 per ton, manure approximately 10s. per bag. If we allow for labour costs at rates current in the district an acre established on similar lines on a similar soil to that on which this co-operative stand has been grown would cost approximately from £4 10s. to £5 per acre. If the stand lasted for, say, five years, with a top-dressing of $1\frac{1}{4}$ cwt. (one bag) of first-grade superphosphate per annum, lucerne-establishment would undoubtedly pay the Hillersden farmer. This statement is, of course, subject to the modification that sufficiently small areas would have to be established to allow of their efficient treatment. It is also necessary that localities should be carefully selected. The soil on which the present stand is situated, while typical of a number of soils in the district, is not wholly typical. The fact that the soil on which the plots are situated cannot be regarded as a particularly favourable one is the more encouraging.

PASTURES.

The second series of trials, on Mr. Bishell's farm, are with various grass-mixtures, all of which were sown on 16th March, 1923.

Plot 1 is a typical temporary pasture (to last one season) consisting of 30 lb. Western Wolths rye-grass and 5 lb. cow-grass. As the plot has been down over eighteen months the Western Wolths has almost entirely disappeared. The cow-grass has remained, while a little perennial rye-grass and white clover have been introduced through stocking. *Danthonia* and sweet vernal, however, are beginning to take possession.

Plot 2, sown with 30 lb. perennial rye-grass and 5 lb. red clover, may be regarded as fairly typical of any flat-land pasture in the Hillersden district sown down at the same time. Already both rye and clover are showing signs of running out.

Plot 3 is a type of permanent pasture which has held well, and which has shown itself to be well adapted to Hillersden conditions. The

mixture is as follows: 15 lb. perennial rye-grass, 10 lb. cocksfoot, 3 lb. white clover, 3 lb. timothy, 2 lb. crested dogtail, 2 lb. *Poa trivialis*, 3 lb. meadow-foxtail, 2 lb. red clover; total, 40 lb. per acre. The most noteworthy feature of this plot was the good showing made by cocksfoot, timothy, and crested dogtail. *Poa trivialis* and meadow-foxtail made little or no showing. While the rainfall in the Hillersden district is fairly good (39 in. average) and well distributed, the soil does not seem to retain sufficient moisture to support these latter grasses.

Plot 4—sown with 25 lb. cocksfoot, 10 lb. perennial rye-grass, and 5 lb. timothy; total, 40 lb. per acre—is an example of a pasture in which grasses are provided for the oversward, but with the turf-forming elements omitted. It was found that white clover and cow-grass had come in through stocking, but weedy and poor patches showed plainly the need of another turf-former such as crested dogtail.

Plot 5 is sown as follows: 8 lb. cocksfoot, 15 lb. Italian rye-grass, 2 lb. white clover, 3 lb. timothy, 8 lb. perennial rye-grass, 2 lb. crested dogtail, 2 lb. *Poa trivialis*, 2 lb. cow-grass; total, 42 lb. per acre. This is a mixture containing an excess of the temporary element—Italian rye-grass. Usually the inclusion of as much as 15 lb. of Italian would result in the smothering or at least in the partial suppression of the cocksfoot. Such, however, has not been the case on these plots. Probably the Italian rye has been instrumental in preventing the growth of much *danthonia* in the early stages of the pasture's establishment.

Plot 6 was designed to illustrate the effect of including a permanent element in what would otherwise be a short-rotation pasture, as follows: 25 lb. to 30 lb. perennial rye-grass, 5 lb. cocksfoot, and 6 lb. red clover per acre. This plot is quite a good one—in fact, only slightly inferior to No. 3.

The Plot 7 mixture was designed to show the effect of the inclusion of an excess of crested dogtail. In this instance the heavy sowing of crested dogtail has proved beneficial rather than injurious. The grasses sown were as follows: 10 lb. perennial rye-grass, 8 lb. cocksfoot, 8 lb. crested dogtail, 3 lb. white clover, 3 lb. timothy, 2 lb. *Poa trivialis*, 3 lb. meadow-foxtail, 2 lb. red clover; total, 39 lb. per acre.

Plot 8 served to show the effect of the inclusion of *danthonia*, the mixture being as follows: 15 lb. perennial rye-grass, 10 lb. cocksfoot, 2 lb. crested dogtail, 3 lb. white clover, 3 lb. *Danthonia pilosa*, 2 lb. *Poa trivialis*, 3 lb. meadow-foxtail, 2 lb. red clover; total, 40 lb. per acre. *Danthonia* is now coming in much more rapidly in this plot than is the case with those mixtures in which it was not included.

Plot 9 was sown with 30 lb. prairie-grass (pure) per acre. The plot has now run out almost entirely to *danthonia* and sweet vernal.

All these grass-plots were treated with a manurial mixture of 1 cwt. Nauru ground rock phosphate and 1 cwt. Nauru superphosphate at time of sowing. Last winter all the plots were again given a similar dressing of manure. The plots have been regularly stocked with sheep and spelled at intervals in order to follow as far as possible the actual farming practice of the district.

It may be affirmed with confidence that so far these plots have amply demonstrated the value as well as the necessity for a pasture of greater permanence than those commonly sown in the Hillersden district. Cocksfoot, timothy, and crested dogtail have all made good showings, and merit inclusion in the mixtures sown in future by local farmers.

WEEDS AND THEIR IDENTIFICATION.

(Continued.)

BARNYARD-GRASS (*PANICUM CRUS-GALLI* L.).

ESMOND ATKINSON, Biological Laboratory, Wellington.

OF the great family of grasses there are very few members that must be looked upon as serious weeds in New Zealand. As regards arable land, perhaps the most important are twitch (*Agropyron repens* (L.) Beauv.), *Poa pratensis*, and creeping-fog (*Holcus mollis* L.). While it does not rival these three grasses as a weed, barnyard-grass*—judging by the number of specimens that are every year received for identification at the Biological Laboratory—always arouses a great deal of interest wherever it is found. For this reason, therefore, a short account of the plant is included in this series of articles.

DESCRIPTION.

The name *Panicum Crus-galli* L. (syn. *Echinochloa Crus-galli* (L.) Beauv.) includes a number of closely allied races differing from one another in various ways, but sufficiently alike to justify—for all practical purposes—their being grouped under one name. The following description is purposely made general enough to cover all the forms that are likely to be met with in New Zealand. Barnyard-grass is an annual allied to the millets, with culms* from 2 ft. to 5 ft. high, which often branch near the base and may be more or less decumbent there. The culms are sometimes quite slender, but are not infrequently as thick as those of a cereal. The leaf-sheaths (basal parts of the leaves which inclose the stem) are smooth and hairless. The blades are also without hairs, but are sometimes rough on their edges; they range from $\frac{1}{4}$ in. to 1 in. in width and from a few inches to 1 ft. or more in length. As a rule they spread rather widely from the culms, and this characteristic, together with their comparatively great width in proportion to their length, helps to distinguish the grass from most other common ones in New Zealand. The photograph (Fig. 1) shows these features quite plainly, but it should be pointed out that it was taken from a patch of the grass that had been eaten back and had made a quantity of second growth. Early in the season the plant is much taller and more upright, as well as being heavier in the seed-heads and culms.

No one who has looked at all closely at any of the common grasses in New Zealand can have failed to notice a small (often very small) whitish or semi-transparent projection at the junction of the blade of the leaf and its sheath. This structure, which is called the ligule, is often of great assistance in identifying the grass. In barnyard-grass there is a white strip at the junction of the blade and sheath, but the ligule is entirely lacking (see Fig. 2, f), its absence affording a rough-and-ready way of distinguishing the grass when it is out of flower.

* The name given to the jointed hollow stems of grasses.



FIG. 1. PATCH OF BARNYARD-GRASS THAT HAS BEEN EATEN BACK AND IS SHOWING SECOND GROWTH.

The "seed-head" of barnyard-grass consists of from four to fifteen or more one-sided branches which are given off at intervals from the uppermost few inches. The upper branches lie more or less closely against the culm, while the lower ones spread more widely. The latter are up to about 2 in. in length; those farther up are shorter (see Fig. 2, *d*). By the expression "one-sided branches" is meant that the flowers or "seeds" are borne in rows (in this case in three or four rows) on one side of the axis, the other side being clearly visible throughout its length. A glance at the drawing (Fig 2, *e*) will make this description clearer, and will also show that long bristles project at intervals from the axis of the branch. The branches of the seed-head are not unlike those of *paspalum*, and in the north barnyard-grass is sometimes known as "bastard *paspalum*."

The final clusters of flowers in a grass are called spikelets, each of which contains one or more flowers. In barnyard-grass each spikelet contains only a single flower and consequently only a single "seed." The drawing (Fig. 2, *b*, left) shows the structure of this spikelet, which need not be further described. It will be noticed that one of the boat-like coverings of the "seed" is tipped with a long bristle, which is called an awn. Fig. 2, *b* was made from a form of the grass with long awns, while in *a*, *d*, and *e* they are very short. This great range in the length of the awns produces correspondingly great differences in the appearance of the seed-head, and is very confusing to any one trying to identify the grass. It is quite a common thing, however, to find the awns almost lacking in second-growth seed-heads, while those borne by the same plant earlier in the season were bristling with them.

It should be mentioned here that some forms, especially early in the season, have the whole seed-head strongly tinged with purple, while others are quite pale in colour.

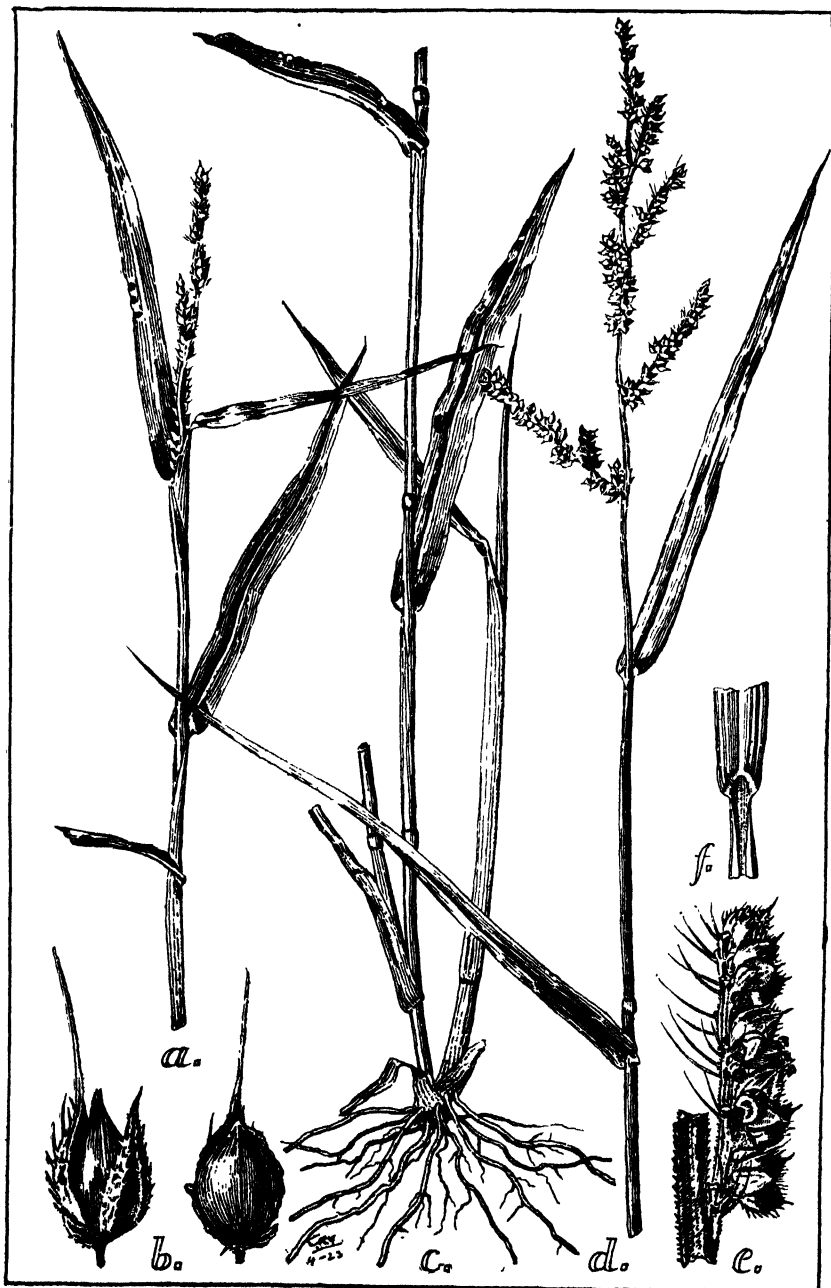


FIG. 2. BARNYARD-GRASS (*Panicum crus-galli* L.).

(a), (c), and (d) "Seed-heads," leaves, culms, &c., about half natural size ;
 (f) junction of leaf-blade and sheath, natural size ; (b) details of spikelet, enlarged ;
 (e) branch of "seed-head," enlarged.

DISTRIBUTION AND POSITION AS A WEED.

Barnyard-grass is widely distributed in New Zealand as a weed of roadsides, gardens, and cultivated ground generally. It is commonest in the north, becoming much less abundant in the colder parts. Specimens, however, have been received this year from Westport and Timaru, and it may quite possibly occur still farther south. Outside New Zealand the grass is found—in one form or another—in nearly all warm countries and in many temperate ones as well. In some countries certain forms are considered valuable forage plants, while others are grown for the seed, which is used as a food. Among the useful forms Japanese millet is the best known in New Zealand, as it is often and increasingly cultivated here. Other names for the more weedy forms are cocksbur-grass and water-grass.

In this country the plant is essentially a summer annual, disappearing during the winter. In a hot season it often makes its appearance in extreme abundance, and may then be a really troublesome weed of cultivated crops chiefly owing to its large size and rank habit of growth, though fortunately it succumbs readily to ordinary cultivation methods. It must be remembered that barnyard-grass ripens large quantities of seed, and that it is this factor alone that determines its reappearance in the next season, so that the early destruction of the plants is of the first importance in the control of the weed. It is often said that barnyard-grass is greedily eaten by stock, and this is quite true; but wherever the weedy form grows, Japanese millet—a greatly superior forage plant—will flourish and should be used in preference.

TESTING OF PUREBRED DAIRY COWS.

NOVEMBER CERTIFICATE-OF-RECORD LIST.

Dairy Division.

THE appended list gives particulars for all cows which received certificates during November, 1924. A number of excellent performances are recorded, including several 700 lb. and 800 lb. butterfat-yields, but no class-leaderships are affected.

LIST OF RECORDS.

* Cow milked three times daily during whole lactation period. † Milked three times daily during part of period.

Name of Cow and Class.	Tested by	Age at Start of Test	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
JERSEYS.						
Junior Two-year-old.		Yrs. dys.	lb.		lb.	lb.
Jersey Brae Favourite	A. E. Watkin, Takanini ..	2 8	241·3	365	11,384·1	630·83
Ngahiwi Romance ..	W. J. Freeth, Waitara ..	1 329	240·5	365	10,575·2	622·21
Alfalfa Lassie ..	F. J. Saxby, Hamilton ..	1 357	240·5	365	8,899·3	539·10
Woodlands Countess	H. C. Sampson, Hillsborough	2 0	240·5	363	8,836·3	531·32
Clemora's Clematis†	W. T. Williams, Pukehou ..	1 363	240·5	365	11,613·5	527·05
Woodlands Bright Jewel	H. C. Sampson, Hillsborough	1 309	240·5	365	8,217·9	524·94

LIST OF RECORDS—*continued.*

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat rec'd for Cert.	Yield for Season.		
				Days	Milk.	Fat.

JERSEYS—continued.

<i>Junior Two-year-old—continued.</i>		Yrs. dys.	lb.		lb.	lb.
Silverstream Choice	G. B. Hull, Wellington	1 362	240·5	365	9,641·6	483·53
Fox						
Oaklands Lady Brampton	F. W. Cornwall, Bell Block	1 354	240·5	329	8,093·0	478·78
Jersey Park Flower ..	W. Pollock, Hawera	1 339	240·5	357	8,079·9	475·46
Jersey Park Little Prim	W. Pollock, Hawera	1 247	240·5	365	7,946·3	475·27
Ivondale Baroness ..	P. J. Petersen, Brixton	1 264	240·5	365	10,733·2	473·77
Ngahiwi's Merry Queen	W. J. Freeth, Waitara	1 363	240·5	349	8,319·5	467·85
Meadowvale Refinement	E. O'Sullivan and Sons, Tariki	1 361	240·5	365	7,721·4	465·50
Woodlands Daphne ..	H. C. Sampson, Hillsborough	1 227	240·5	365	7,530·6	464·28
Royal Oak Silvery ..	A. J. Hale, Hillsborough	1 296	240·5	365	8,076·0	461·99
Favourita's Princess ..	A. N. Haylock, Stratford	2 33	243·8	365	8,399·7	460·34
Beechland's Playful ..	A. Moreland and Sons, Te Rapa	1 322	240·5	365	8,618·1	446·81
Ngahiwi Miss Demure	W. J. Freeth, Waitara	2 3	240·8	341	8,366·6	445·55
Hillview Mrytle ..	W. R. Shattock, Te Rapa	2 29	243·4	365	8,010·0	443·03
Grasmere Wairoa ..	H. J. Berry, Kaupokonui	2 0	240·5	365	7,542·2	441·97
Kuranui Kate ..	O. Glynn, Morrinsville	1 315	240·5	365	7,650·7	437·20
Mayfield's Lady ..	R. J. W. Hancock, Brixton	1 345	240·5	365	6,992·2	431·62
Royal Oak Rosalie ..	A. J. Hale, Hillsborough	1 291	240·5	365	7,261·9	428·14
Meadowvale Peggy O'Neil	E. O'Sullivan and Sons, Tariki	1 355	240·5	360	6,892·7	427·15
Dainty Victress ..	W. McKenzie, Palmerston North	2 35	244·0	365	7,689·9	422·80
Rose of Blythburn ..	D. Wishart, Ryal Bush	1 296	240·5	332	7,354·0	419·08
Grasmere Heroine ..	H. J. Berry, Kaupokonui	2 13	241·8	365	7,420·2	416·80
Meadowvale La Sultane	E. O'Sullivan and Sons, Tariki	2 55	246·0	350	6,951·3	411·24
Meadowvale Melody ..	E. O'Sullivan and Sons, Tariki	2 0	240·5	334	8,197·9	405·18
Hawkesbury Golden Lily	R. C. Jury, Tikorangi	1 337	240·5	365	6,788·6	403·74
Burnside Duchess ..	S. J. Hollard, Rowan	2 24	242·9	361	6,922·0	400·69
Mayfield's Queen ..	R. J. W. Hancock, Brixton	1 283	240·5	365	7,569·1	399·66
Pinewood's Berry ..	G. H. Bell, Oakura	1 361	240·5	365	6,977·8	397·90
Distinction's Laurino	W. R. Shattock, Te Rapa	2 25	243·0	360	7,326·6	377·19
Burnside Primula ..	S. J. Hollard, Rowan	1 362	240·5	359	6,220·0	366·39
Gowanbrae Tulip ..	O. C. Sutton, Richmond	2 13	241·8	355	6,711·7	361·44
Holly Oak Trixie ..	Aickin and McCarroll, Woodhill	1 345	240·5	365	6,338·3	357·00
Kaiwhare Lola ..	N. V. Cederman, Richmond	1 331	240·5	365	6,992·1	348·72
Springlea Tawa Leaf	W. H. Hall, Carterton	2 31	243·6	365	7,197·3	334·13
Edgarley's Joy ..	T. A. Millar, Tuakau	1 187	240·5	365	5,575·3	297·57
Hill View Fay ..	Aickin and McCarroll, Woodhill	2 20	242·5	296	5,585·1	268·52
Taumata Park Star Queen	W. D. Knowles, Whenuakura	2 35	244·0	254	4,656·7	260·77
<i>Senior Two-year-old.</i>						
Meadowvale Perfect Day	E. O'Sullivan and Sons, Tariki	2 346	275·1	364	9,284·9	611·96
Beechlands Valeta ..	A. Moreland and Son, Te Rapa	2 363	276·8	364	8,736·8	524·86
Helen Douglas ..	S. R. Lancaster, Palmerston North	2 349	275·4	365	8,656·5	452·01

LIST OF RECORDS—continued.

Name of Cow and Class.	Tested by	Age at Start of Test.	Fat req'd for Cert.	Yield for Season.		
				Days.	Milk.	Fat.
FRIESIANS —continued.						
<i>Mature—continued.</i>		Yrs. dys.	lb.		lb.	lb.
Rosevale Burkeyje Sylvia*	H. North and Sons, Omimi	5 326	350·0	365	15,120·9	574·39
May Pontiac Pietertje 5th*	John Court (Ltd.), Auckland	6 63	350·0	321	18,030·0	530·95
Maid of Leith de Kol*	John Court (Ltd.), Auckland	6 48	350·0	340	14,942·2	521·99
Heather Girl of Lakeside*	R. R. Pearson, Rongotea ..	10 337	350·0	340	16,137·7	504·28
Carlowrie Belle* ..	R. K. Macdonald, Edendale	5 61	350·0	285	14,991·5	483·46
MILKING SHORTHORNS.						
<i>Senior Two-year-old.</i>						
Matangi Pauline 2nd†	Ranstead Bros., Matangi ..	2 300	270·5	360	7,732·3	304·53
<i>Junior Three-year-old.</i>						
Cloverlea Fillpail 2nd	D. Buick, Palmerston North	3 43	281·3	365	13,768·9	547·11
Braeside Red Plume 2nd†	P. J. McLeod, Te Pua ..	3 126	289·6	331	8,117·7	346·29
<i>Junior Four-year-old.</i>						
Sherwood Solution† ..	Ranstead Bros., Matangi ..	4 94	322·9	365	11,021·8	415·68
<i>Mature.</i>						
Studleigh Nancy Lee	D. Buick, Palmerston North	9 353	350·0	365	16,142·8	620·85
Riverdale Florrie† ..	T. W. Wardlaw, Waimana	Mature	350·0	315	12,665·6	606·69
Eleam Lady† ..	Hanson Bros., Parakai ..	8 41	350·0	365	12,439·1	555·28
Sunnymead Molly† ..	Hanson Bros., Parakai ..	11-12 yrs.	350·0	350	14,026·8	541·61
Riverdale Lady† ..	T. W. Wardlaw, Waimana	Mature	350·0	315	13,982·4	502·57
Riverdale Grace 2nd†	T. W. Wardlaw, Waimana	Mature	350·0	300	11,964·1	415·87
AYRSHIRES.						
<i>Two-year-old.</i>						
Sprightley of Carmel Glen	A. W. Foulds, Kumeu ..	2 6	241·1	343	8,540·1	373·11
<i>Mature.</i>						
Pearl II of Edendale	W. Hall, Lepperton ..	8 18	350·0	365	11,300·2	490·24
Kate of Edendale ..	W. Hall, Lepperton ..	6 28	350·0	348	10,168·6	429·45
Second-class Certificates.						
JERSEYS.						
<i>Junior Two-year-old.</i>						
Baby of Blythburn ..	D. Wishart, Ryal Bush ..	1 231	240·5	365	8,359·5	465·56
Bridge View Dolly ..	A. L. Hooper, Mahoe ..	1 333	240·5	348	7,343·9	455·08
<i>Four-year-old.</i>						
Jersey Meadows Sunday	H. H. Phillips, Te Rehunga	4 322	345·7	365	11,428·5	611·29
<i>Mature.</i>						
La Frescia ..	F. J. Saxby, Hamilton ..	5 338	350·0	365	9,896·8	573·94
FRIESIANS.						
<i>Junior Two-year-old.</i>						
Glen Iris Countess Ena*	R. R. Pearson, Rongotea	1 351	240·5	365	14,102·8	526·39
Friens Mercedes Piebet	D. Dickie, Wellington ..	2 149	255·4	365	9,840·6	352·77
MILKING SHORTHORNS.						
<i>Senior Two-year-old.</i>						
Waitangi Camelia 2nd	A. J. McGovern, Kiokio ..	2 252	265·7	365	9,444·4	355·86

SEASONAL NOTES.

THE FARM.

CEREAL HARVEST.

THE grain harvest usually follows quickly on haymaking. For threshing it is generally recognized that both wheat and oats are better cut on the green side than allowed to become overripe. The latter condition involves much risk, and heavy loss may occur from a wind-shake; furthermore the sample of grain is brighter and better in quality when the crop is not allowed to become overripe. Barley, for malting, however, should not be reaped until quite ripe. The proper time to reap wheat is when the straw immediately below the head becomes yellow, and is free from moisture when tightly twisted, with the grains still a little soft but not milky or doughy. At this stage the skin or bran is finer, and the grain yields a higher proportion of flour to bran and pollard, while if the crop is left to become overripe both the latter increase in proportion. On the other hand, care must be observed not to cut too green, otherwise there will be a loss of weight by shrivelling. A certain amount of filling occurs after the grain is in stook.

The size of the sheaves should be regulated to suit the climatic condition and the condition of the crop. If the weather is damp the sheaves should be tied smaller to facilitate drying. Again, should there be an undergrowth of grass or weeds in the butts of the sheaves they should be made small for the same reason, and if very bad they are better left lying a day or two before stooking. This is especially important when dealing with barley with much undergrowth, as this grain is so easily discoloured, which greatly reduces its value for malting.

It always pays to take some pains in making a good stook. The average stook should consist of from eight to ten sheaves, each sheaf being firmly placed with sufficient slant to withstand a reasonable wind and turn a fair amount of rain. Considerable loss often occurs from careless stooking, the grain becoming discoloured or even sprouting when the stook falls and is left lying.

After the crop has been in stook for two or three weeks, according to weather (and if threshing from stook is not practised), stacking will follow. For this a convenient site on high ground should be selected, and a bottom made up of old logs, branches, or hedge-clippings. If the stack is to stand for some time before chaffing or threshing it is imperative that the foundation be good. The size of the stack naturally depends on the bulk of the crop and area of the field. The building commences by forming a stook in the centre and working round in tiers or courses to the marked boundary, keeping the sheaves as upright as possible. The secret of good stack-building is to build the heart firm and always higher than the outside courses from foundation to ridge. Too many stacks of both hay and sheaves are only well built on the outside courses, while the inner ones are loosely or carelessly

placed, the consequence being that later, as the whole bulk settles down, the heart sinks most, leaving the sheaves slanting downwards towards the centre, and ready to convey moisture to the heart, whereas the opposite should be the aim. The skilful builder will slightly spring the stack from the foundation to the eave. This allows the rain to drip clear, and with a well-built heart kept high, causing a slant from the centre to the outside, water will not penetrate. The novice should endeavour to see his first stack opened up, so that he may profit from any mistakes.

ROOT CROPS AND GREEN FORAGES.

The end of the year will see most of the root crops sown, the exceptions being swedes on the higher country. These may be sown any time up to the middle of January. After this it is safer to sow turnips—Hardy or Imperial Green Globe for preference—and after the end of January stubble sowing will be best. When seeding at this time of the year care should be taken to work the land down fine and roll firm so as to ensure moisture for the young seedlings.

The thinning of mangold and carrot crops should be pushed along. If mangolds are holding and looking at all yellow a top-dressing with 1 cwt. of nitrate of soda per acre will often put new life into the crop, provided that there is sufficient rain to melt the nitrate.

In districts with suitable climatic conditions misses among the mangold and turnip crops may be filled up with cattle-marrows (kumi-kumis). The best method is to plant groups of two seeds each about 3 ft. apart, using a hoe and working in a little super and blood-and-bone at the same time.

Soft turnips for dairy cows should be fed sparingly, both to avoid taint and to make the crop last as long as possible. The larger roots should be pulled first. Purple-tops are the first of all varieties to lose their succulence and to decay; they should therefore be used early, but in strict moderation, as they are most liable to injure the quality of the milk or cream. Red Paragon, Green Globe, and Devonshire Greystone are all better keepers and safer feed. No progressive dairy-farmer should allow his cows to have access to the turnip-paddock even for short periods. It is best to pull the turnips a couple of days ahead and allow them to wilt before feeding.

Millet should be grazed when not more than 10 in. high, and spelled at intervals. The best plan is to let the cows graze it for an hour or two after milking.

FIELD PEAS AND BEANS.

On rich land in a damp season it is somewhat difficult to judge just when to cut the pea crop, as in some cases the bottom pods may be overripe and shelling while the tips of the haulms are still flowering, with pods in various stages in between. In such cases mowing should be done when the greatest number of pods commence to shrivel and before they open. The cut material should be cocked in small heaps like hay, and handled as gently as possible. If the crop is badly laid the hay-rake may be used instead of a mower. Threshing can be done direct from the paddock if the weather permits.

As a rule the bean crop is not ready until after the cereals are cut. The pods should be black and the stems turning dark before reaping.

SPECIAL HAY CROPS.

In the south the late hay crops consisting of oats and pea mixtures will be ready to cut during January. The proper stage for harvesting these crops is when the oats are in a tough, doughy stage, and the peas are filling the pods. The peas must not be allowed to overripen, otherwise much loss will result when the crop is harvested. As it is, a considerable proportion of peas will fall to the ground. These may be utilized by turning sheep on to the stubble. Another method of utilizing any peas which may have fallen is to run the disk cultivators over the stubble, and so allow the peas to germinate. A catch-crop very suitable for late autumn feeding will thus be obtained. The yields from the oats and pea mixtures have in the past been most satisfactory, and if saved in good condition the material makes a splendid hay or chaff for feeding in the winter along with turnips. Similar crops intended for ensilage will also be ready for operations in January.

—*Fields Division.*

THE ORCHARD.

FRUIT HARVEST.

THE season is now at hand when all energies will be devoted to the picking, grading, packing, and marketing of fruit. In order to give this portion of the work all the attention it requires, together with the spraying necessary for keeping in check the various pests and diseases, cultivation will have to be reduced to a minimum. If cultivation is carried out in a proper manner up to New Year very little will be needed during the next few months. However, if a cover-crop is contemplated a little preparation will be necessary before it is sown in February.

It should now be fairly easy to estimate the extent of the crops of both stone and pip fruits, and every endeavour made to secure a full supply of cases, if this has not already been done. During the busy season, when both stone and pip fruits are being dealt with, everything should be in readiness so as to handle the crops as expeditiously as possible.

PICKING AND PACKING.

If it is worth while to exercise care and skill in growing the fruit it is equally important to take pains at the harvest. Just when and how the fruit should be picked depends largely on the species or variety, and on the distance it has to be shipped. The closer and better the market, the riper the fruit should be when gathered. It would seem to be unnecessary to say that all fruits intended for a good market should be hand-picked, and yet it is a fact that such fruit is often shaken from the trees. After fruit is picked it is very important that it should be kept cool and away from the sun. The correct time to pick can scarcely be described in words; experience in the orchard is the best teacher.

It is impossible to carry out the packing operations in a successful manner if a convenient packing-shed is not available. Packing in

the orchard has little to recommend it, as it is not feasible to carry out this operation under adverse weather conditions.

SPRAYING.

Codlin-moth, leaf-roller caterpillar, and pear-slug will all be in evidence at this period, and trees should be sprayed with arsenate of lead—paste 1 lb., or powder $\frac{1}{2}$ lb., to 30 gallons water. For powdery mildew on apples use atomic or atomized sulphur, 8-100; for black-spot on apples and pears, lime-sulphur, 1-125, or bordeaux, 3-4-50. It is a great mistake to think that one or two sprayings are sufficient to control these pests and diseases. It is necessary to repeat the applications well on into the autumn. Woolly aphids will now be working freely, and the trees should receive a dressing of Black Leaf 40, 1 pint to 100 gallons water, plus 3 lb. soap, the application being repeated in two weeks if necessary.

Where bud-weevil is troublesome in raspberries they should be sprayed immediately after the fruit is packed, using arsenate of lead, 2 oz. to 4 gallons water. This pest does considerable damage by eating out the buds from the new canes.

—*L. Paynter, Orchard Instructor, Christchurch.*

CITRUS-CULTURE.

Phenomenal blossoming has taken place in most orange-groves and in the majority of lemon-orchards. The blossoming, however, is rather later than usual this season, doubtless owing to the wet weather experienced. Growers will therefore have to time their bordeaux application for the control of fungoid diseases accordingly, bearing in mind that the most opportune time to make the necessary application is when the majority of the blossoms have dropped from the petals. It can be anticipated that the humid conditions existing at the present time may cause such disease to give slightly more trouble than is usually the case, and, that being so, it may be necessary to make a second application of bordeaux, 4-4-40, which should be carried out some three weeks to a month after the first.

Thrip has been rather troublesome in some lemon-groves, and recently it is noticeable that Eureka and Villa Franca suffer the most in this regard. Where the red-oil emulsion, 1-40, has not been fully effective an application may be made, with benefit, of nicotine sulphate, at the rate of 1-750. Such spray will also control any black aphids that may be present.

The spray applications referred to may be considered to be the most important of the season, and, as pointed out in previous notes, the very best results are obtained by the use of a power sprayer, using spray guns. The infection of citrus-trees by either fungoid disease or insect pests is always much in evidence on the under portion of the leaves. It becomes necessary, therefore, that this portion of the trees should be very well covered with spray, and the best results are obtained in this respect as mentioned.

With regard to cultivation, the chief work will be scarifying and hoeing around the trees where necessary, the latter applying chiefly to young growing trees.

FIREBLIGHT.

Although it is a little on the early side at this juncture to state definitely that the commercial areas in the Auckland District are entirely free from fireblight infection for this season, it may now be reasonably supposed that as no infection has so far taken place in those areas there is little risk of an outbreak in regard to blossom-infection. However, it does not follow that other districts are yet entirely safe in this respect, and the strict watch which has been maintained should be continued without relaxation.

STRAWBERRIES.

Harvesting the crop is now the chief work of the commercial grower. Already large quantities have been put on the Auckland market, and the regulations for the packing of this class of fruit for sale have been brought into operation. Strawberry-growers generally in the Auckland District are to be congratulated on the manner in which they have come into line in compliance with the regulations. They will be gratified to know that retailers report increased demand by the public on account of the improvement in the pack.

—J. W. Collard, Orchard Instructor, Auckland.

POULTRY-KEEPING.

SUMMER MANAGEMENT.

JANUARY is one of the most trying months of the year, both in regard to the adult and developing stock. It is therefore a time which demands the greatest care and diligence on the part of the poultry-keeper for the birds to do their best. Especially is it necessary to give the late-hatched chickens the best possible care and attention that can be bestowed upon them if they are to make payable layers. Good shade is imperative. In addition they must receive an ample supply of good nourishing food. Green food is especially necessary at this period of the year, and cannot be oversupplied. Cleaning operations must be vigorously pursued, or vermin are almost sure to give trouble. At all costs guard against overcrowding—the common cause of young stock receiving a check in development. Do not attempt to rear weaklings or deformed stock. They should never be bothered with; better far to destroy them at the outset, and thereby save the worry of trying to rear birds which, if they come to maturity, may never pay for their keep. Again, it is the weakling which is apt to catch every passing ailment, and may thus be the means of introducing serious trouble into a flock.

I would again urge the importance of weeding out all surplus cockerels that have attained a marketable age—namely, those between four and a half and five months old. There is a great advantage in having these out of the way. Not only is there a saving in the present costly food, but the clearance also allows more space for the growing pullets, to say nothing of the saving in labour and attendance.

Broody hens should not be allowed to sit on the nest for weeks at a time. It not only means a loss in eggs, but the encouragement of vermin. Such hens should be removed to the broody-coop immediately they show a desire to sit, while the better they are fed and managed the sooner will they resume egg-laying.

IMPORTANCE OF GOOD FEEDING.

At the present time many of the birds in the average laying-flock will present a worn, thin appearance as a result of continuous heavy laying. Obviously such birds are the best layers. It is therefore imperative that they be given as much food as they will eat, in order to enable them to produce to their maximum capacity. Stupid advice is often given that it is a mistake to provide laying-birds with all the food they will take. It is now an accepted fact that the high-type layer when in a laying condition cannot be overfed with the right class of food. It stands to reason that such a small animal as our modern White Legorn, laying from six to eight times her own weight in eggs in a year, must necessarily have the material, and that of the right kind, to do it with, and then have something to maintain the great bodily vigour demanded of her.

Of course, the poor layer or the bird that has passed her best period of usefulness can easily be overfed, and they will soon declare the fact by becoming overfat. Thus, in contrast with the good layer, these low producers will exhibit a heavy and well-kept appearance, simply because while the good layer is converting her food to the manufacture of eggs the low producer turns into body flesh and fat. Obviously the latter should be culled out, for the laying-on of condition proves her to be an unprofitable layer of eggs. The only really payable bird is the one which gives up her life to egg-manufacture, and she must be encouraged in every way (especially by good feeding) if she is to make a thorough success of the business. Good feeding does not mean a feast one day and a famine the next; it means regular and liberal feeding of sound grain material, animal food, and green-stuff, while sharp gravel grit and crushed oyster-shell should be in reach of the birds at all times.

A CHICKEN TROUBLE.

Many complaints have reached me of late regarding a trouble affecting chickens after being removed from the brooder to the colony house, or before the young birds have commenced to perch. The first symptom observed is a dark greenish colour surrounding the hock joints and under the wings. Later the neck and head swell, and from then on the body gradually becomes discoloured and in a more or less moist condition. At this stage death is usually not far off.

When this trouble makes its appearance it is usually looked upon by poultry-keepers as some mysterious disease over which they have no control; but this is not so. In all cases where I have been called upon to advise its cause has been solely traced to mismanagement, either by overcrowding the chickens or compelling them to sleep in damp or badly ventilated quarters. The trouble is most common where the floor of the house is on a level with or, worse still, below the ground-surface surrounding it, as obviously such a house cannot

be maintained in a thoroughly dry condition. The foundation or wall plate of a poultry-house should be at least 6 in. to 8 in. above ground-level, and the inside filled up with well-rammed earth. This will aid in keeping the house dry, a condition which is imperative for the welfare of the growing chickens. Another cause of the trouble is bedding the chickens with hay, which heats and brings on a sweated condition. Hay may certainly be used to advantage as bedding-material in a heated brooder, because it is there prevented from becoming damp, but in a fireless brooder or a colony coop or house it should never be used, otherwise trouble may be expected at any time. Straw, straw chaff, sand, or dry earth is always to be preferred.

There is no cure for the trouble referred to ; prevention is the one and only way. The essentials for prevention are avoidance of overcrowding, provision of ample ventilation, keeping the quarters clean and dry, and checking anything likely to create a moist atmosphere. In addition, encouragement of the birds to perch at an early age is always a safeguard against the trouble making its appearance.

In connection with early perching it may be mentioned that where a chicken is encouraged to perch at an early age the breast-bone is apt to become deformed, especially where very narrow perches are provided. On the other hand, if broad perches of, say, not less than 3 in. in width are used the number of birds affected with this trouble will be reduced to a minimum.

—F. C. Brown, *Chief Poultry Instructor.*

THE APIARY.

QUEEN-EXCLUDERS.

THE coming month should prove the advantages to be gained by the use of excluders. In the colder districts they are of inestimable value in enabling the beekeeper to finish extracting before the hot weather has altogether departed. Generally speaking, they should only be used during the main honey-flow. All sealed brood should be raised above the excluder, and the queen confined in the brood-chamber on drawn-out combs. After a few days the brood in the super should be examined in case queen-cells have been started, as it is almost impossible to find brood-combs which do not contain a few eggs, and the bees will often raise queen-cells on brood from which the queen has been separated. The queen will continue to lay on the empty combs provided, and, as the brood in the upper story hatches, the combs will be filled with honey—a great boon to the beekeeper who does not wish to extract brood-combs. By delaying the use of excluders till the main flow has started, one of their chief disadvantages—the promotion of excessive swarming—is largely obviated, as in most localities swarming stops automatically when clover blooms freely.

EXTRACTING.

By the end of December extracting should have begun in the warmer parts of the Dominion, though farther south it may not

commence till some little time later. The utensils for handling the honey should be thoroughly cleansed and scalded, and set up in the position they will occupy during the season. Everything should be tested to see that it will stand the strain of the season's work. Extracting is such high-pressure business that there is little time to stop for repairs once it commences in earnest. The uncapping-knives should be sharpened, strainers fitted with clean cheese-cloth, brakes and belts inspected, and all machinery oiled and cleaned, so that matters may run smoothly during the few weeks that the main business of the apiary is in progress.

The honey may be extracted as soon as the combs are three-parts capped, and the operation repeated two or three times during the season. In fact, keeping the extractor running from the time the main flow sets in is perhaps the most satisfactory way of dealing with a honey crop, and is to be recommended where there is a possibility of thick honey being gathered. However, in clover districts, when the beekeeper possesses plenty of supers, the honey may be left in the hives till the end of the flow, and all the extracting done at one time. Although this ensures prime, well-ripened honey, it makes the handling of the crop very heavy work, and will give more trouble from robbers, which are always very much in evidence at the end of the season. In addition, in the colder localities heavily supered hives are apt to become chilled during the later part of the summer, and cold honey is much more difficult to extract than warm.

Once the honey leaves the hives it should be handled as cleanly and expeditiously as possible. Two or three zinc trays are a big help in disposing of drips, &c. One placed on the barrow which conveys the supers of combs to the honey-house, and another on the floor of the house to receive the supers prior to uncapping, will save much unpleasantness to clothes and feet. These trays should have small blocks or supports fastened in each corner to raise the supers a little, so that the drippings from burr combs, &c., may be drained away from the bottom edge of the supers. These trays are easily washed at the end of the day and drained dry ready for the next using. The extractor, uncapping-can, and honey-tank when not in use should be kept covered with clean washing covers, and care should be taken that all bees, flies, and other extraneous things are excluded from the honey. From the peculiar nature of honey-production it is impossible to clean utensils day by day as is done with most foodstuffs, and it is imperative that honey be prevented from coming into contact with dirt and foreign substances.

PROVISION OF SUPERS.

On no account must the beekeeper neglect to provide his swarms with storage room. If the weather is normal, from ten to fifteen days after a strong swarm is hived it should be provided with a super. Not only is this necessary in order to obtain a surplus, but if it is not done the newly created colony will probably swarm again. A swarm is most vigorous and will usually make more headway than an established colony, and therefore should be encouraged by the provision of ample room. Many beekeepers deplete their honey crops considerably by failing to realize the fact that early swarms particularly will invariably yield a large surplus in a favourable season.

VENTILATION.

Every care should be taken to provide the bees with plenty of ventilation during the height of the summer. All entrances should be enlarged to their utmost capacity, and where the bees show a tendency to excessive fanning or clustering out the hive should be raised from the bottom-board, and any obstruction such as weeds, grass, &c., should be cleared away from the entrances. Most important of all, ample room should be provided by means of supers, as the overcrowding of the hive will tend to make the bees loaf if it does not produce excessive swarming.

FOUL-BROOD.

As soon as settled weather sets in, the beekeeper should carefully examine his hives for disease, and, if necessary, treat as soon as possible, so as to give his bees a chance to gather a surplus from the main flow. On no account should the operation be delayed until the bees are bringing in large quantities of the nectar that the beekeeper requires for extracting. The "shake" or McEvoy method is the only one advocated, and the combs and frames should be treated and disposed of as soon as possible after the hives are dealt with.

QUEEN-RAISING.

The beekeeper should devote all the time he can spare to the important work of replacing old and failing queens, and if his stocks are of good quality he should endeavour to raise as many queens as possible in his own yard. Cells built under the swarming-impulse are splendid for this purpose, and there are many ways of artificial queen-raising which are to be recommended. All the cells to be hatched should be given to nucleus hives to care for; queen-cells are seldom a success when introduced to full colonies. As soon as the young queens are mated and laying they should be placed in poor colonies, after killing the old queens, and their places filled by other ripe cells.

—*E. A. Earp, Senior Apiary Instructor.*

THE GARDEN.

VEGETABLE-CULTURE.

THE planting-out of the remaining winter crops—Brussels sprouts, broccoli, savoy cabbages, and kale—should now be proceeded with as soon as the plants are ready. The greatest care should be taken with this operation. Soak the beds well the day before lifting the plants. Lift the plants carefully and place them in trays for planting, keeping them in cool shade until they are wanted. Plant firmly in well-prepared land, watering them in.

It is important to lift onions, shallots, and garlic as soon as they ripen, leaving them in the sun for a few days to thoroughly ripen off. They may then be cleaned up and stored in a cool, dry, airy place. Firm, well-ripened onions are all too scarce; this valuable crop deserves more careful storage.

When lifting the early potato crop care is needed to avoid exposing the tubers to the ravages of the potato-moth, especially in a spell of dry weather. To sort and bag them before evening is the most effective way of saving them from the attentions of this night-flying insect that causes so much damage. Grade out all the small, diseased, and damaged tubers, and carefully select seed for the next crop. A dark cool store is the most suitable place for holding potatoes.

Asparagus and rhubarb beds that are at all backward should be watered well if at all dry, and fed liberally on the "little and often" principle to encourage strong growth.

A sowing of salads for autumn use and of peas for a late crop should now be made.

TOMATOES.

The outside tomato crop will now require constant attention in trimming and tying the vines. To neglect this important work, especially where the plants are close together, is to experience a great loss of crop. As soon as the fruit commences to set, the plants may be fed by applying liquid manures or broadcasting fertilizers on the surface and hoeing them in. The tomato-plant has a special liking for superphosphate.

Under glass, the harvesting of the tomato crop will be half completed. The superior-quality fruit from indoor plants usually makes it worth while to continue giving them attention till they are finished. Sometimes, however, they are neglected in favour of other work, and the house becomes close and hot and the plants badly diseased. This is a mistake; rather than neglect the plants they should be removed and burnt and not allowed to infect the house with fungus spores that occasion a great deal of work later.

SMALL FRUITS.

The berry crops will now be gathered—and, too often, the beds forgotten until winter. This is a serious oversight, as the next season's crop depends more than anything on the autumn growth. If this is clean and strong the prospects are good. In too many cases it is to the contrary, and the beds quickly go back and become unpayable and have to be replanted.

Most raspberry-gardens are more or less affected with leaf-spot, scales, and other insects. If when the crop is gathered the old bearing-caness are cut close to the ground and removed with all weak and superfluous suckers and carefully burnt, the remaining canes may be efficiently sprayed, and, with suitable cultivation, should finish the season in good condition.

Similarly, strawberry-beds, where they are being kept on for another season, should be cleaned up, the old foliage and runners being removed, the plants sprayed (and fed where necessary) and carefully cultivated during the autumn-growing weather. In this way they are regenerated, and can be expected to do well the following season. The same applies to other plants of this class.

TOBACCO.

Where the tobacco crop was planted out in good time it will now be approaching maturity. That stage is shown by a slight drooping

of the leaf and a mottling of yellow spots, commencing on the lower leaves first. When this condition develops on the middle leaves the plant should be harvested at the first opportunity. Avoid doing this shortly after a considerable fall of rain, as the leaf for a while will be thin and in poor condition. The best conditions are after and during bright sunny weather, when the leaf will be found to contain those aromatic qualities that increase its value. The method is to split the stalk to within 6 in. of the ground, and then cut it off at ground-level, leaving the plants on the ground for a while—an hour or so—till wilted. They are then threaded on the curing-sticks, spacing them about 4 in. apart, and carted to the curing-shed.

If the plants are wilted too long in a hot sun or dried quickly in the curing-shed the plant-cells are killed and the leaf loses its texture. Such tobacco when used carbonizes badly—a very common fault. The arrangement of ventilators is made with a view to controlling this development, retarding the drying-process somewhat at first until the leaf has mellowed and most of the green colour has gone out. The process is then quickened, and an endeavour made to secure an even and satisfactory colour. What happens is the development of an oxidizing agent throughout the leaf, which is responsible for the chemical changes in its constituents—changes that are completed in the further operation of fermentation. If this development is retarded too long, as it might be in cold wet weather, there is danger of fungus and bacterial troubles arising, hence the need of endeavouring to mature the plants at a period when bright warm weather may be expected.

—W. C. Hyde, *Horticulturist*.

Inspection of Imported Fruit, Plants, &c.—The Horticulture Division reports that the bulk of the consignments in 1923-24 arrived in good order and condition. The fruit inspected was practically clear of fruit-fly infection, only a small quantity being condemned on account of this pest. Fumigation was necessary, however, in connection with a number of lines found on examination to be affected with live scale and mealy bug. Several consignments of almonds badly attacked by the Indian meal-moth (*Plodia interpunctella*) had either to be reshipped or destroyed, and similar action was necessary in regard to a quantity of imported bulbs infected with bulb-mite.

Work at Wallaceville Veterinary Laboratory.—The annual report of the Livestock Division states that during the year 1923-24, 1,522 specimens were received at the Laboratory for examination, comprising 794 milk-specimens for contagious mammitis, 155 for the biological test for tubercle bacilli, 241 blood-specimens for contagious abortion, and 119 specimens from Stock Inspectors, the remainder being of a miscellaneous pathological nature. There were also received a number of specimens connected with dairy bacteriology, concerning which work has been undertaken in conjunction with the Dairy Division. An investigation as to the cause underlying the complaint of sterility in dairy cows, now troublesome among cows in dairying districts, is in progress. Field officers' observations had narrowed the work to granular vaginitis and contagious abortion, but the *Bacillus abortus* has now been eliminated as a factor in sterility as the result of the examination of a number of blood-specimens from herds where vaginitis was prevalent. The form of sterility present therefore appears to be the result of granular vaginitis. Various methods of treatment of affected animals have been tried, but nothing better than simple astringents used in the acute stage has so far been ascertained. During the year, 71,250 doses of black-leg vaccine prepared at the Laboratory were sent out for use by officers.

CARE OF HOME-SEPARATOR CREAM.

CAUSES OF BAD CREAM.

1. Unhealthy cows ..
2. Feed-flavours
3. Dirty sheds and yards ..
4. Careless milking ..
5. Dirty milking-machines
6. Unclean utensils ..
7. Washing separator once daily
8. Skimming too thin ..
9. Not cooling cream ..
10. Not stirring cream ..
11. Mixing hot and cold cream
12. Holding cream in kerosene-tins
13. Dirty and badly ventilated separator-rooms
14. Keeping cream too long before sending to the factory
15. Leaving cream standing in the hot sun
16. Rusty cans

THE REMEDIES.

1. Don't separate the milk from a cow which has not been cleansed or is otherwise unhealthy.
2. Most feed-flavours can be partly removed by cooling and stirring, the exceptions being turnips, garlic, and similar flavours.
3. Milk absorbs flavours from dirty surroundings. Where machines are used the air is actually admitted into the milk-pipes. Hence unclean surroundings mean bad-flavoured milk.
4. Teats and udders must be washed with a clean cloth and clean water from a clean bucket, and then dried before milking. Water must also be provided for washing the milker's hands.
5. Milking-machines must be treated as advised in special instructions issued by the Department.
6. Buckets, separators, &c., must be rinsed with cold water, scrubbed in warm water with a brush, cleanser to have been added to the water, then scalded with boiling water immediately after separating.
7. A separator which is washed only once daily is a direct loss to the owner, as it will not skim clean the second time it is used, and will taint all the cream passing through it.
8. Skim a cream containing about 40 per cent. of fat; it will carry well, and will not quickly develop bad flavours.
9. Run the cream over a small cooler as it leaves the separator. Attach the water-inlet hose to the lower end of the cooler. Stand it in cold water afterwards.
10. Stir frequently with a metal plunger, but don't use a wooden stirrer.
11. Never mix hot and cold cream. Use a clean can or bucket for each skimming, and keep them separate if possible until sending to the factory.
12. Kerosene-tins are not suitable for use in a dairy unless the seam round the bottom and the lap round the top have been properly soldered.
13. The separating-room must be kept as clean as a butter-factory, and have at least two large ventilators, one at the bottom and the other at the top on opposite walls, and should not be placed near the yard. The engine must not be in this room.
14. Don't fail to send the cream away on the days arranged by the factory, daily if possible.
15. Protect the cans from the sun while waiting for the collecting-wagon.
16. Rusty cans impart a most objectionable flavour to cream. Have them retinned.

DON'T use the separating-room as a general storeroom. Don't use a cloth to wash tinware; use a brush. Don't use sandsoap for scouring tinware. Don't use a cloth strainer unless you wash and scald it daily. Don't use the cans returned from the factory until you have scalded them. Don't mistake **WARM** water for **BOILING** water.

—Dairy Division.

THE DAIRY INDUSTRY AMENDMENT ACT, 1924.

1. This Act may be cited as the Dairy Industry Amendment Act, 1924, and shall be read together with and deemed part of the Dairy Industry Act, 1908 (hereinafter referred to as the principal Act).

Validation of certain Allotments of Shares in Co-operative Dairy Companies.

2. (1.) Every allotment of additional shares to any shareholder of a co-operative dairy company heretofore made by the directors of the company shall, if made in conformity with the terms of the articles of association or of any amendment of such articles, and notwithstanding that such articles or amendment thereof may be *ultra vires* of the company, be deemed to have been validly made, and the shares so allotted shall be deemed to have been accepted by the shareholders to whom they were respectively allotted in accordance with the terms of the allotment, save that nothing herein shall apply with respect to the allotment of shares being the subject-matter of the judicial determination of the Supreme Court in the case of *Macdonald versus The Normanby Co-operative Dairy Factory Company, Limited* (reported in the *New Zealand Law Reports*, 1923, pages 123 to 148); or with respect to the allotment of shares to any shareholder who, within six months after receiving notice of such allotment, heretofore gave to the company notice in writing of his objection to receive such shares, and within the said period of six months permanently ceased to be a supplier of milk, cream, or other dairy-produce to the company. Nothing in this subsection shall be construed to authorize the allotment of any shares after the passing of this Act, or to validate any allotment made after that date, if such allotment would be invalid if this Act had not been passed.

(2.) Every person to whom the directors of any co-operative dairy company have heretofore purported to allot shares in the company, but who was not a shareholder prior to such allotment, shall be estopped from denying the validity of the allotment if, being at the date of the allotment a supplier of milk, cream, or other dairy-produce to the company, he did not within six months after receiving notice of such allotment give to the company notice in writing of his objection to receive such shares, and within the said period of six months permanently cease to be a supplier of milk, cream, or other dairy-produce to the company.

Validation of certain Articles of Association as to Supply of Dairy-produce.

(3.) The provisions in the existing articles of association of any co-operative dairy company purporting to oblige the shareholders of that company to supply milk, or cream, or other dairy-produce to the company shall be deemed to be and at all times since the making thereof to have been valid and effective, and to have imposed on the shareholders, according to the tenor of those articles, an obligation to supply such milk, cream, or other dairy-produce to the company; and any penalty prescribed by such articles for failure so to supply such milk, cream, or other dairy-produce shall be deemed to be and to have been lawfully fixed, and every shareholder who hereafter makes default in complying with the terms of the articles shall be liable accordingly:

Provided that nothing in this subsection shall apply with respect to the articles of association of the Cheddar Valley Co-operative Dairy Company, Limited, in their application, before the passing of this Act, to the appellant in the case of *Shalfloon versus The Cheddar Valley Co-operative Dairy Company, Limited* (reported in the *New Zealand Law Reports*, 1924, pages 561 to 596):

Provided also that nothing in this subsection shall be construed to authorize the inclusion, after the passing of this Act, of provisions in any articles of association purporting to oblige the shareholders of any company to supply milk, cream, or other dairy-produce to the company; and all articles of association to which this subsection applies (being articles made before the passing of this Act) shall, on the expiration of six months after the passing of this Act, cease to have any force or effect, save so far as they may be valid and effective irrespective of the provisions of this subsection.

Noxious Weeds Orders.—Broom, gorse, and variegated thistle have been declared to be noxious weeds within the County of Waipawa.

THE POULTRY ACT, 1924.

[An Act to regulate the keeping of poultry and the sale and export of poultry and eggs.]

1. This Act may be cited as the Poultry Act, 1924.

2. In this Act, if not inconsistent with the context, "Disease" means tuberculosis, roup, fowl-cholera, chicken-pox, and any other disease affecting poultry which the Governor-General from time to time, by Order in Council, declares to be a disease within the meaning of this Act. "Eggs" includes pulped or dried eggs. "Inspector" means an Inspector appointed under this Act. "Owner" includes the occupier of any premises on which poultry are kept, or are exposed for sale, or are held or stored, and also includes any person having charge of any poultry. "Poultry" means domestic fowls, ducks, geese, and turkeys, and includes the carcase of any such birds.

3. There may from time to time be appointed such Inspectors, Graders, and other officers or persons as may be required for carrying out the provisions of this Act.

4. An Inspector may at any time enter upon any land or premises or into any conveyance or ship where he has reason to believe that any poultry or any eggs intended for sale or export may be, and may there inspect for the purposes of this Act any poultry or eggs, or any buildings, equipment, or appliances used in connection with any poultry.

5. All poultry exposed for sale, or held, stored, or kept on any premises, shall be kept under sanitary conditions; and an Inspector may, by notice in writing in the form prescribed, require the owner of any poultry, within the time limited in the notice, to remedy any specified defect in such conditions, or to abandon any insanitary practice or the use of any insanitary appliance, or to remove on the grounds specified the poultry from the premises.

6. Every owner of poultry who is guilty of cruelty towards them by reason of overcrowding, or of the failure to provide adequate shelter, food, or drink, or by reason of any other act or default, commits an offence against this Act.

7. (1.) Every owner of poultry shall within twenty-four hours notify an Inspector of any outbreak of disease discovered or suspected amongst his poultry, and shall either forthwith destroy any birds which are diseased or suspected to be diseased, or, as far as practicable, isolate any such birds from other birds.

(2.) When an Inspector finds that any poultry are diseased he may, by notice in writing in the form prescribed, direct the owner of such poultry to comply with any of the following requirements: (a) Forthwith to destroy in the manner set out in the notice such diseased poultry and any other poultry with which they have come into contact; (b) not to remove for a period set out in the notice any poultry from the premises on which such diseased poultry was kept; (c) forthwith to take such other steps for the prevention of the spread of disease as may be set out in the notice.

(3.) If any such owner fails to take any measures or do any acts required as aforesaid, the Inspector may himself perform the same at the expense in all things of the owner, who nevertheless shall not thereby be relieved from any liability that he may have incurred under this Act by reason of his default.

(4.) Any expenses incurred by an Inspector under the last preceding subsection shall be repaid to the Inspector on demand, and in default thereof the amount of such expenses may be recovered from the owner as a debt due to the Crown.

8. No person shall knowingly sell, or offer or expose for sale, or have in his possession for sale, any poultry which is diseased.

9. For the purposes of this Act every person shall be deemed to sell any poultry or eggs who sells the same either on his own account or as the agent or servant of any other person, and in the case of any sale by an agent or servant his principal or employer shall be under the same liability as if he had effected the sale personally.

10. Every person who obstructs any Inspector or other officer in the performance of his duties, or who fails to comply with any direction given by an Inspector or with any of the provisions of this Act, or who commits any offence against this Act, shall be liable on summary conviction to a fine of twenty pounds.

11. The Governor-General may from time to time, by Order in Council, (a) declare any disease of poultry to be a disease within the meaning of this Act; (b) specify the ports from which alone poultry or eggs shall be exported; (c) appoint stores at which poultry or eggs shall be graded.

12. The Governor-General may from time to time, by Order in Council, make regulations for all or any of the following matters, that is to say: (a) Prescribing the sanitary requirements that must be observed in the keeping of poultry, or holding or storing poultry on any premises, or in the carriage of poultry; (b) regulating the marketing of poultry and of eggs for consumption in New Zealand, and providing for the grading and packing of such poultry and eggs; (c) regulating the export of poultry or of eggs, and providing for the grading and packing of poultry and of eggs for export from New Zealand; (d) prescribing reasonable charges for the grading of poultry or eggs or for other services rendered by officers under this Act; (e) prescribing forms of notice and other forms required under this Act; (f) generally providing for such matters as are contemplated or deemed necessary for giving full effect to this Act.

ANSWERS TO INQUIRIES.

IN order to ensure reply to questions, correspondents must give their name and address, not necessarily for publication, but as a guarantee of good faith. Letters should be addressed to the Editor.

GREASY HEEL IN HORSES.

C. S. OSBORN, Rakaia:—

Will you please state what you consider the best cure for greasy heels in horses?

The Live-stock Division:—

Except in very slight cases a cure of greasy heel is very difficult to effect. The disease is primarily constitutional, and therefore internal as well as external treatment is necessary. For the former a dose of physic given occasionally is necessary. An aloes ball in a dose from 4 to 6 drams, according to the size of the horse, is the most suitable. The external treatment is as follows:—Clip all the hair from the heels and fetlocks, and liberally apply the following lotion once daily to the affected parts: Zinc sulphate, 2 oz.; Bol Armen, 1½ oz. Add this to a quart of water, and shake well before using. The materials can be obtained from a chemist. Keep the horse as much as possible out of wet places, and, if standing in the stable, keep the floor clean from urine and dung. If the horse is badly affected a cure is practically impossible, but by using the above treatment the trouble can be kept in check and the objectionable condition lessened.

CONTROL OF DODDER.

C. P. WICKSTEED, Stratford:—

In the spring of 1923 I sowed a paddock in oats and grass, cutting the oats for hay in January. I now find a parasite, which appears to be dodder (specimen enclosed), evenly distributed throughout the paddock, and have concluded it was introduced in the clover-seed when sown. Is it possible to eradicate dodder by cultivation? Would it die out if left, the pasture being grazed with dairy cows? Will dodder seed and spread over the whole farm?

The Fields Division:—

The specimen is dodder, and, as you suggest, it was probably introduced with the clover. Dodder may be eradicated by cultivation, but to effect this it is necessary to avoid growing any crop containing legumes, such as clover or lucerne, for two or three years. Dodder is not likely to die out on a pasture, so long as there is any clover left, where the grazing is done by dairy cows. Close grazing with sheep would probably help to control it. Dodder seeds and is spread by stock, the seeds passing through cattle similarly to clover.

APPLES WITH BITTER-PIT.

A. E. BOWLER, Matamata :—

We have a few apple-trees (Northern Spy, Gravenstein, Sturmer), the fruit of which was mostly spoilt by brown spots just under the skin. At first it only affected the Northern Spy; now all the fruit is about the same. Is there any spray or treatment that will cure the trees of this disease?

The Horticulture Division :—

The brown spots just under the skin of your apples are probably due to a trouble known as bitter-pit. The spots are formed, it is supposed, by the sudden flooding and rupture of the pulp-cells, which afterwards become oxidized. The trouble is common on young and over-vigorous trees carrying but a few fruits, especially in a season when extreme wet and dry conditions are experienced. When trees settle down to moderate growth and carry a full crop, chiefly on the laterals, the trouble is generally considerably lessened.

CONTROL OF POTATO-MOTH.

A. CULLEN, Maungaturoto :—

We have had great trouble in the past to keep our potatoes from the moth. What is the best thing to do when storing potatoes through the winter?

The Fields Division :—

This insect pest is very troublesome, and requires very careful attention to the methods used for controlling it. If you wish to keep the potatoes through the winter in storage you must begin in the field—that is, provided you are growing the potatoes yourself. The following measures are recommended: Seed infected with the pest should not be used for planting. Land where the moth was present in the previous season should not again be used for potatoes. In sowing seed plant deeply, so that the seed is well covered. Practice thorough and clean cultivation so as to cover all the tubers; in hilling this is especially necessary. Weeds, such as nightshade and other plants of the potato family, should be destroyed, as these provide breeding-places for the moth. When the moths are seen about the crop spray with arsenate of lead. When digging potatoes do not leave them exposed in the field, as this is a common means of infection; they should be stored so that the moths cannot get at them to deposit their eggs. When bagging in the field, bags should be sewn without delay. Do not put potato-tops over the bags, as the tops may contain moths or caterpillars. All dead plants and small tubers that are not required should be collected and destroyed; the tops can be burnt, while the tubers may be boiled and fed to pigs and poultry. Old sacks which held infected potatoes should be dipped in boiling water. If the potatoes are stacked during the winter in a tight room they can be fumigated. On the top of the sack place a shallow vessel, and into this put some bisulphide of carbon, and close the door tightly. This should be repeated about every ten to fourteen days. Four or five such fumigations should be sufficient. About 5 lb. of liquid bisulphide should be used for every 1,000 cubic feet of space. The gas is highly inflammable, therefore no lights of any kind should be allowed near it. In the absence of a tight room draw the potatoes into a heap, place a saucer containing carbon bisulphide on the top, and cover the whole with canvas or tarpaulin, and fumigate in this way.

PARALYTIC TROUBLE IN YOUNG PIGS.

"TROUBLE," Matamata :—

I have had a lot of deaths in young pigs from a few days old up to twelve weeks. They stagger about, and in facing the wind throw up their head and paw the air with front feet and cannot make headway. Some have a discharge from the eyes, and last year some had their eyes sealed right up. They have had a run on artichokes and pasture, and been fed with skim-milk, concentrates, &c.—all the food they can take. Can you help me, please?

The Live-stock Division :—

The animals are probably affected with a form of paralysis, or loss of power in the limbs, which is frequently met with in young pigs. This is usually attributed to a dietetic cause—feeding on skim-milk which has been allowed to become too sour before feeding giving rise to gastritis. Another cause is to be found in cold, damp styres exposed to the prevailing winds. If this applies in your case, removal of the styres to a well-sheltered, warm place, and attention to dryness of the floor, &c., are suggested as preventive measures. The sows' feed should be looked into. It is possible that you have been overfeeding, and that the milk is proving too rich for the sucking-pigs.

SALT FOR DAIRY STOCK.

J. H. MATHEWS, South Norsewood :—

Can you tell me when is the best time to put rock salt out for stock, also if any special make of boxes is recommended for salt to be put in ?

The Live-stock Division :—

Salt in moderate quantity assists in the formation of flesh. Salt exists in a natural condition in food and water, and normally it should not be necessary to supplement it. In the case of dairy-cows, however, a good deal of the natural chlorine goes in the milking, and it is necessary to add salt to the daily ration. In the late season and in the case of winter cows, when salt is more necessary, it is better added to the feed in the form of ordinary salt. A handful once daily should be sufficient. Rock salt is apt to be wasted if fed in the paddocks, and it is better to place it in a box at the bail-head for the cows to lick during the milking.

NEW ZEALAND CROP STATISTICS : SEASON 1923-24.

Crop.	Area.	Yield per Acre.	Total Yield.
Wheat—	Acres.		
Grain	173,864	24.01 bushels	4,174,537 bushels.
Chaff, &c.	1,629	1.32 tons ..	2,146 tons.
Oats—			
Grain	63,842	30.77 bushels	1,964,511 bushels.
Chaff, &c.	326,652	1.12 tons ..	366,546 tons.
Barley—			
Grain	21,286	28.07 bushels	597,416 bushels.
Chaff, &c.	590	1.61 tons ..	976 tons.
Maize—			
Grain	8,208	49.40 bushels	405,855 bushels.
Ensilage	958	6.12 tons ..	5,852 tons.
Peas and beans	18,676	19.43 bushels	362,787 bushels.
Linseed—Seed	12,119	0.22 tons ..	2,705 tons.
Rye-grass—Seed	43,487	332.58 lb. ..	14,519,187 lb.
Cocksfoot—Seed	11,619	122.85 lb. ..	1,428,759 lb.
Chewings fescue—Seed	9,279	161.57 lb. ..	1,499,177 lb.
Crested dogstail—Seed	4,749	156.53 lb. ..	753,836 lb.
Red clover and cow-grass—Seed	5,543	143.41 lb. ..	1,213,835 lb.
White clover—Seed	4,161	132.77 lb. ..	581,676 lb.
Other grasses and clovers—Seed	2,225	146.84 lb. ..	326,863 lb.
Grasses and clovers cut for hay	188,979	1.67 tons ..	317,616 tons.
Potatoes	20,993	5.00 tons ..	105,552 tons.
Green fodder	239,652	..	..
Turnips	477,381	..	..
Mangolds	9,989	..	..
Onions	374	8.76 tons ..	3,278 tons.
Hops	701	1,374.34 lb. ..	963,415 lb.

WEATHER RECORDS: NOVEMBER, 1924.

Dominion Meteorological Office.

GENERAL SUMMARY.

THE weather returns for November again show a higher temperature than is usual for the month. Rainfall was above the average in the Auckland, Taranaki, Nelson, and Marlborough Provinces, which was owing to two ex-tropical disturbances—one at the beginning of the month, and another culminating about the 18th. These did not account for heavy rains in other parts of the Dominion, where records show that rainfall was below the average. Westerly disturbances also passed on the 2nd, 16th, and 27th, but, except for the one about the 16th, were only of moderate intensity.

Barometric pressure was somewhat unsteady, but mostly above the normal. Many parts of the country report warm and sunny conditions, and phenomenal growth was experienced except in some parts where the rainfall was deficient.

—D. C. Bates, Director.

RAINFALL FOR NOVEMBER, 1924, AT REPRESENTATIVE STATIONS.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average November Rainfall.
<i>North Island.</i>				
	Inches.		Inches.	Inches.
Kaitaia	1·80	8	0·48	3·27
Russell	4·10	7	2·00	1·61
Whangarei	4·01	13	1·92	3·41
Auckland	4·68	12	1·54	3·27
Hamilton	4·11	12	0·87	4·05
Kawhia	4·91	13	1·48	4·49
New Plymouth	5·20	13	1·04	4·58
Inglewood	8·93	13	3·03	8·95
Whangamomona	6·75	12	1·88	7·40
Tairua, Thames	11·00	10	2·90	3·55
Tauranga	5·09	15	1·97	3·26
Maraehako Station, Opoitiki	5·15	13	1·32	2·78
Gisborne	2·26	12	0·50	3·15
Taupo	3·58	11	0·78	3·41
Napier	1·77	10	0·96	2·08
Maraekakaho Station, Hastings	0·56	11	0·11	2·03
Taihape	1·75	12	0·47	3·67
Masterton	2·32	10	0·63	2·87
Patea	3·23	11	1·09	3·72
Wanganui	2·46	6	1·03	3·31
Foxton	1·88	7	0·56	3·80
Wellington	2·93	12	0·70	3·46
<i>South Island.</i>				
Westport	8·56	20	1·39	7·08
Greymouth	8·62	15	1·78	9·46
Hokitika	12·60	16	2·76	10·73
Arthur's Pass	12·47	16	2·25	15·00
Okuru, Westland	11·96	15	1·82	12·96
Collingwood	5·39	13	2·10	7·68
Nelson	6·70	14	1·25	2·87
Spring Creek, Blenheim	3·52	8	1·60	2·41
Tophouse	5·13	14	1·50	7·07
Hammer Springs	4·78	8	1·87	2·91
Highfield, Waiau	4·50	8	2·42	2·52
Gore Bay	3·06	7	2·18	1·98

RAINFALL FOR NOVEMBER, 1924—continued.

Station.	Total Fall.	Number of Wet Days.	Maximum Fall.	Average November Rainfall.
<i>South Island—continued.</i>				
Christchurch	2.47	7	1.33	1.84
Timaru	1.56	9	0.46	1.97
Lambrook Station, Fairlie ..	1.50	6	0.43	2.00
Benmore Station, Omarama ..	1.98	11	0.70	2.05
Oamaru	2.05	8	1.35	1.94
Queenstown	2.34	7	1.02	2.77
Clyde	1.24	5	0.42	1.36
Dunedin	1.69	8	0.50	3.30
Gore	1.13	9	0.34	3.08
Invercargill	0.86	12	0.30	4.60

FORTHCOMING AGRICULTURAL SHOWS.

Rangitikei A. and P. Association: Taihape, 14th and 15th January.
 Woodville A. and P. Association: Woodville, 20th and 21st January.
 Waimarino A., P., H., and I. Association: Raetihi, 22nd January.
 Tapanui Farmers' Club: Jubilee Show, Tapanui, 28th January.
 Pahiatua A. and P. Association: Pahiatua, 30th January.
 Manototo A. and P. Association: Ranfurly, 6th February.
 Clevedon A. and P. Association: Clevedon, 7th February.
 Dannevirke A. and P. Association: Dannevirke, 11th and 12th February.
 Te Puke A. and P. Association: Te Puke, 12th February.
 Rodney Agricultural Society: Warkworth, 14th February.
 Northern Wairoa A. and P. Association: Mititai, 17th and 18th February.
 Masterton A. and P. Association: Solway, 17th and 18th February.
 Te Awamutu A., P., and H. Association: Te Awamutu, 18th February.
 Whakatane A. and P. Association: Taneatua, 18th February.
 West Coast A. and P. Association: Greymouth, 18th and 19th February.
 Rotorua A. and P. Association: Rotorua, 20th February.
 Waipapua P. and I. Association: Ruatorea, 25th and 26th February.
 Tauranga A. and P. Association: Tauranga, 26th February.
 Opotiki A. and P. Association: Opotiki, 26th February.
 Franklin A. and P. Association: Pukekohe, 27th and 28th February.
 Omaha and Pakiri A. and H. Association: Leigh, 28th February.
 Taumarunui A. and P. Association: Taumarunui, 4th March.
 Waikato Central A. Association: Cambridge, 4th and 5th March.
 Mangonui A. and P. Association: Mangonui, 6th and 7th March.
 Morrinsville A., P., and H. Society: Morrinsville, 11th March.
 King-country Central A. and P. Association: Te Kuiti, 12th March.
 Matamata A. and P. Association: Matamata, 19th March.
 Mayfield A. and P. Association: Mayfield, 21st March.
 Methven A. and P. Association: Methven, 26th March.
 Temuka and Geraldine A. and P. Association: Winchester, 2nd April.

Agricultural and Pastoral Association Secretaries are invited to supply dates and location of their shows for publication in this list.

Compensation for Condemned Stock.—Compensation to the amount of £12,918 was paid out during the year 1923-24 for 5,363 animals condemned in the field for disease under the Stock Act, and £13,266 for carcasses or parts of carcasses condemned for disease on examination at time of slaughter at abattoirs and meat-export slaughterhouses, &c., under the provisions of the Slaughtering and Inspection Act. This made the total amount for which the Consolidated Fund became liable during the year £26,180, an increase of £591 on the previous year's figures.

BONUS FOR A METHOD OF EXTERMINATING BLACKBERRY.

The following notice was issued in the *Gazette* of 27th November :—

Department of Agriculture,
Wellington, 19th November, 1924.

The New Zealand Government hereby offers, subject to the conditions stated below, a bonus of ten thousand pounds (£10,000), payable in New Zealand, for an efficient, practical, and economical method of exterminating blackberry, otherwise than by cultivation or farm-management methods such as seeding, tree-planting, or live-stock manipulation.

Applicants for the bonus must prove to the satisfaction of a Committee (to be appointed by the Minister of Agriculture) by actual trials commencing at the times, and continuing over the periods, specified by the Committee, and on areas of blackberry not less than one acre in extent to be provided for the purpose by the Government—

(1.) That the method is fully effective in exterminating blackberry at a cost not more than double that of cutting the plants down to about ground-level by hand on land similar to that on which the trials are made.

(2.) That the method does not impair the normal fertility of the soil or its capacity for producing pasture plants, or cause risk to the health of farm animals afterwards depastured upon the land where the method has been applied.

(3.) That the method is readily applicable to and effective against blackberry growing on land of all classes, including broken and steep country and land carrying rocks, stumps, and felled timber.

Applicants must state in their applications full particulars of the method they propose, including the amount of water (if any) needed per acre, also the actual cost for each of the following—namely, apparatus, materials, labour, and any other items that are needed for complete extermination of blackberry by the method submitted: the cost to be stated where practicable at per acre, and to have been ascertained by the actual treatment of an area of not less than one acre of heavily infested land that has been successfully dealt with by that method.

Applicants must also state what lump sum (excluding the bonus of £10,000) would be required to purchase the New Zealand rights of their method in the event of such rights being acquired by the New Zealand Government for free use of all occupiers of land in New Zealand; or, if any applicant is unwilling to sell his rights, what royalty he would require for the use of his method.

Applications, giving the full name and the telegraphic and postal addresses of the applicant, must be forwarded by registered post to the Director-General, Department of Agriculture, Box 888, Wellington, New Zealand.

The bonus will be paid to the person whose application is first received by the Director-General and whose method, in the opinion of the Committee, fully complies with the above-mentioned conditions.

W. NOSWORTHY, Minister of Agriculture.

British Market for Peas and Beans.—The following report was cabled by the High Commissioner, London, on 6th December :—

Peas—Blue marrowfats: Japanese now making £24 10s. per ton c.i.f., December/January shipments, after reaching £26. Tasmanian "A" grade sold at £21 to £22 c.i.f. New Zealand ex store worth about £18 to £20. Maple: Market slow. Tasmanian spot quoted at 80s. to 87s. 6d. per 504 lb., sellers; and February/April shipments, 72s. to 75s. Reported sales in new crops at 74s. 6d. New Zealand No. 1 partridge, slow sales spot at 70s. to 77s. 6d. Buyers indicate 65s. to 70s. new crops for shipment early next year. English maple, good supply on hand offering at 50s. to 60s. Beans: English plentiful at] 53s. to 62s. per 53½ lb.

LIVE-STOCK IN NEW ZEALAND, 1924.

Unless otherwise specified, the enumeration is at 31st January.

Land District.	Horses.	Asses and Mules.	Cattle (including Dairy Cows).	Dairy Cows.		Number of Sheep shorn, 1923-24.	Number of Lambs tailed, 1923-24.	Sheep (including Lambs) as at 30th April, 1924.	Pigs.		Goats.	
				In Milk.	Dry.				Angora.	Other.		
North Auckland	..	38,181	40	487,611	22	359	621,143	279,960	683,504	58,586	1,093	1,400
Auckland	..	47,355	2	677,218	288,903	25,174	794,082	408,953	836,599	92,739	1,163	1,553
Gisborne	..	19,697	43	322,443	26,328	4,633	2,801,801	1,343,173	3,028,087	15,083	362	490
Hawke's Bay..	..	16,855	4	259,295	46,880	7,353	2,500,076	1,251,663	2,921,594	15,563	744	363
Taranaki	..	21,868	..	394,407	192,220	11,340	743,502	334,251	757,777	50,541	413	4,158
Wellington	..	43,863	12	711,713	184,450	20,195	4,780,662	2,552,673	5,334,509	64,091	398	570
Nelson	..	7,930	2	66,042	25,179	4,067	349,742	129,992	397,905	12,811	896	1,013
Marlborough	..	7,191	4	48,831	16,371	2,473	908,634	402,855	991,412	7,816	334	2,861
Westland	..	2,609	..	44,891	11,016	2,415	50,879	35,401	57,646	4,323	..	66
Canterbury	..	62,876	30	214,360	86,816	11,918	3,792,392	2,415,079	4,453,312	52,192	167	92
Otago	..	35,095	10	149,402	56,071	8,673	2,484,535	1,210,583	2,857,629	24,271	9	29
Southland	..	26,910	1	187,284	75,778	7,012	1,249,636	708,753	1,455,802	16,255	..	22
Dominion totals	..	330,430	148	3,563,497	1,184,977	127,612	21,077,684	11,133,336	23,775,776	414,271	5,579	12,617
Totals, 1923	..	330,818	205	3,480,694	1,124,671	123,972	20,420,119	10,895,521	23,081,439	400,889	4,338	12,733

THE SEASON'S LAMBING: DOMINION ESTIMATES.

FOLLOWING are complete estimates of the current season's lambing, computed from estimated average percentages furnished by the Department's Inspectors of Stock in the various districts. Corresponding figures for the four previous years, together with the actual numbers of lambs tailed, are also given for comparison.

Year.	Number of Breeding-ewes.	Estimated Average Percentage of Lambing.	Estimated Number of Lambs.	Actual Number of Lambs tailed.
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NORTH ISLAND.

1924	..	7,148,949	85.00	6,049,652	..
1923	..	7,170,154	91.34	6,549,143	6,170,673
1922	..	6,771,482	90.36	6,118,530	5,955,081
1921	..	6,312,456	89.65	5,659,355	5,457,643
1920	..	5,838,704	87.95	5,135,524	5,074,751

SOUTH ISLAND.

1924	..	5,927,145	87.87	5,208,378	..
1923	..	5,892,849	83.99	4,949,313	4,962,663
1922	..	5,724,572	82.53	4,724,475	4,949,440
1921	..	5,835,332	83.28	4,859,425	4,810,258
1920	..	5,729,845	80.20	4,595,426	4,539,797

DOMINION.

1924	..	13,076,094	86.14	11,258,630	..
1923	..	13,063,003	88.02	11,498,456	11,133,336
1922	..	12,496,054	86.77	10,843,005	10,895,521
1921	..	12,147,788	86.59	10,518,780	10,267,910
1920	..	11,568,549	84.11	9,730,950	9,614,548

KILLINGS AT MEAT-WORKS, 1923-24.

FIGURES issued by the Meat Producers Board show the total killings at meat-works in New Zealand for the frozen-meat industry year, 1st November, 1923, to 31st October, 1924, as follows:—

Class.	North Island.	South Island.	Dominion.
Lamb (carcases)	2,108,534	2,661,049	4,769,583
Wether mutton (carcases)	874,230	145,035	1,019,265
Ewe mutton (carcases)	641,996	278,063	920,059
Beef (quarters)	321,338	1,491	322,829
Sundries (freight carcases of 60 lb.) ..	290,338	64,008	354,346

Bush-sickness and Sheep-raising.—The last annual report of the Live-stock Division states: "For a long time it has been a recognized fact that horses, pigs, and poultry can be reared upon bush-sick land without contracting the sickness that inevitably overtakes cattle and sheep. Calves can now be reared with special treatment, and adult cattle, if attacked by bush-sickness, will recover with the right treatment. In order to follow up its progressive policy the Department will now require to turn its attention to preventive and remedial measures in so far as sheep are concerned. Our past experience with cattle should prove invaluable in this connection."

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